FROM DIAGNOSIS TO DISCERNMENT: FOSTERING THE DEVELOPMENT OF CLINICAL JUDGMENT OF PARAMEDIC LEARNERS IN IMMERSIVE HIGH FIDELITY SIMULATIONS

by

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A THESIS SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

in

The Faculty of Graduate Studies

(CURRICULUM STUDIES)

THE UNIVERSITY OF BRITISH COLUMBIA
(Vancouver)

June, 2013

ABSTRACT

Paramedic educators are challenged to produce greater numbers of graduates who are better prepared to function in an evolving health care system. The growth of high fidelity simulation (HFS) holds promise for reducing reliance on the practicum environment, long a crucial step between the classroom and field practice. Yet, despite significant investment in simulation infrastructure, HFS is still seen as an adjunct to, but not a replacement for, practicum placement. The practical problem addressed in this study, then, was the presumption that HF simulation can reduce reliance on practicum placement. The research question explored how HFS influences the development of clinical competence and clinical judgment. This multiple-case study employed a multi-vocal approach, gathering data from 75 classroom and HF simulations. An iterative, inductive process of analysis provided a phenomenological exploration of participants' experiences and interactions and a critical analysis of their judgments and decision making. The findings in this study suggest that existing paramedic simulations and the practicum represent radically different learning environments, each with its own sets of roles, expectations, patterns of practice, and methods of evaluation that call on different epistemological and ontological conceptions of what constitutes competent practice, what knowledge matters most, and how learning occurs. The varied learning activities in this study fostered different ways of knowing as learners moved from the consistency of context-independent skill performance to the socially constructed adaptation of procedures and protocols in dynamic simulations, and, finally, to the socially negotiated understandings arising from co-emergent activity in a field setting. Effective simulations require situational blends of fidelity to create environments realistic enough to meet their pedagogic goals. Simulations intended to foster clinical competence and clinical judgment must provide occasions for discernment; they

must create a milieu involving complex interpersonal interactions and genuine opportunities for clinical decision making. Thus, paramedic simulations must be as concerned with role, environmental, interpersonal, and social/cultural fidelity as with physiological and procedural fidelity. In this sense, populating HFS more richly with actors and authentic interdisciplinary responders may often be as important as the use of HF mannequins and standardized patients.

PREFACE

This thesis has ethics approval from the University of British Columbia, Office of Research Services, Behavioural Research Ethics Board, certificate: H08-02855.

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ABBREVIATIONS

Terms related to levels of training

Abbreviation	Definition
EMS	Emergency Medical Services or Emergency Medical Systems: Modern Canadian ambulance services are part of comprehensive emergency medical systems that include civilian awareness, priority dispatch, prearrival care (dispatchers providing over-the-phone instructions to bystanders at the patient's side), layered levels of response ranging from first responders to critical care paramedics, and deeper integration of prehospital care with the overall health system (Bledsoe et al., 2005; Caroline, 2010; PAC, 2001)
EMR	Emergency Medical Responder: Entry-level paramedic practitioner in Canada. EMRs provide basic life support assessment and treatment, including symptomatic relief procedures. Canadian EMR education programs are typically 3 weeks in length.
PCP	Primary Care Paramedic: Intermediate-level paramedic practitioner in Canada. PCPs provide basic life support assessment and treatment, drug administration via PO, SL, SC, IV, IM, and inhaled routes, employ supraglottic airway devices, and automatic external defibrillation. Canadian PCP education programs are typically one- to two-years (four semester) in length.
ACP	Advanced Care Paramedic: ACP paramedics provide advance life support assessment and treatment, including the use of invasive procedures, including intubation, manual defibrillation, cardioversion, surgical airway, chest decompression, and pharmacological interventions for conditions affecting airway, breathing, and circulation. Canadian ACP education programs build on PCP certification and are typically one- to two-years (two to four semesters) in length.

Terms related to paramedic education or field practice

Abbreviation	Definition
35A or Main Cot	Standard type of stretcher used by the paramedic programs at the time of this study.
Code X	Paramedic code used to refer to a case where the patient is not carried or transported to hospital. A call may be a Code X when there was no need for an ambulance at the incident (e.g., a motor vehicle accident with no injuries) or when the patient refuses transport.
HFS	High Fidelity Simulation: Created learning environments which emphasize a selected set of factors that allow the participants to engage with a dynamic, social environment in authentic physical locations. The HF simulations in this study emphasize physiological, procedural, interpersonal, role, intraprofessional, environmental, and social and cultural aspects of the situations they recreate.
NS	Normal Saline. Intravenous solution.
O2	Oxygen
OPA	Oropharyngeal airway; curved plastic tube that is placed in an unconscious patient's mouth to ensure a clear air passage.
RBS	Rapid Body Survey. Quick but thorough assessment of a patient, performed in the Primary Survey with the intention of identifying and stabilizing all life- and limb-threatening injuries or conditions (e.g., Major bleeding).
ROS	Robertson Orthopedic Clamshell. Plastic or metal lifting device that splits into two halves. The segments are placed on either side of a patient, then reconnected.

GLOSSARY

Terms related to clinical judgment

Term	Definition
Competence	A dynamic internal construct of what a learner knows and can do; potential patterns of response to novel and/or dynamic environments.
Technical competence	Defined in this study as the consistent, independent (un-coached), timely, accurate, and appropriate performance of skills, knowledge, and decision making as outlined by an external authority and assessed through observable behaviours (calls upon a definition from the Canadian Medical Association Conjoint Accreditation Services, 2007a).
Clinical competence	The ability of the practitioner to adapt and integrate procedures and strategies within the dynamic, social environment of field practice.
Clinical judgment	An emergent process characterized by the learner/practitioner's increasing awareness of and ability to incorporate an increasingly complex set of contextual factors and relationships into their decisions and (inter)actions.
Professional practice	Also called *Field Practice* or simply *Practice.* The holistic and integrative performance of an experienced practitioner in a specific domain or discipline.
Practice within one's discipline	To function at a high level—to know, think, make decisions, function, and perform within a profession or discipline.

Terms related to simulation

Term	Definition
Authentic	Referring to situations, practices, and conditions found in every-day practice. The term is used in this study to describe the every-day aspects of some function or activity as generally understood by practitioners in that context. For example, an authentic location for a pedestrian struck call would be a road intersection.
Fidelity	A set of dynamic, overlapping, nested relationships between selected elements in a learning environment and the field setting it is representing. In this sense, the fidelity of any learning experience, such as a simulation, is conceived of as its fit with its intended pedagogical purpose. The fidelity of a simulation, then, is the intersection of a set of factors that match different blends of realism to the educational and pedagogical requirements of the desired learning outcome.
Human patient simulators	Or: High Fidelity Mannequins: Interactive mannequins with computers that allow accurate portrayal of physiological signs (such as ecg and heart rate) that can be dynamically changed during a simulation by manual control or preprogrammed responses to participant actions (such as administering a specific medication or performing a procedure such as defibrillation).
Mastery	In this study, the term is used in the sense of learning a skill or procedure through guided practice, repetition, and internalization. Mastery, from a cognitivist perspective, is demonstrated through achievement of technical competence: consistent, independent (un-coached), timely, accurate, and appropriate performance of a procedure compared to a clearly articulated set of observable behaviours.
Practice learning activities	Created experiences, centred on activity, with the goal of fostering the development of competence, proficiency, or expertise within a specific domain or community of practice
Simulation (learning activity)	A three-phase learning activity (set up, scenario, debrief), designed around a pedagogical goal, in which participants interact with other participants, the environment, and an instructor/preceptor in the context of performing a "call." Some or all aspects of the situation may be represented through simulation.
Simulation (the educational act of)	The purposeful creation of a learning environment that dynamically represents a system of selected elements and relationships allowing learners, participants, and physical elements to interact and function with the goal of developing understanding or changing practice/performance within a desired context.

Terms related to paramedic practice

Term	Definition
Algorithm	A set of predefined steps describing the performance of a procedure. In EMS, principles of management or protocols for managing specific injuries or conditions are often presented as algorithms. The steps of the procedure are listed in a vertical "tree," with the first step at the top of the page. Procedures may have "branches" or alternate paths in which specific findings (e.g., the presence or absence of breathing) trigger different sets of subsequent steps (continuing to assess for circulation or intervening to begin artificial respiration).
Call Management	Call management refers to overall management of an ambulance call, including patient assessment and treatment, interpersonal communications, dealing with environmental factors, teamwork, leadership, etc.
Patient Assessment (Patient Assessment Model)	A structured procedure for gathering data in a prioritized manner, develop a provisional diagnosis, and make treatment decisions. The paramedic Patient Assessment Model typically consists of several components: the Primary Survey (prioritized assessment to find and control immediately life-threatening conditions), the Secondary Survey (focused on diagnosis), Treatment, Transport, and Documentation.
Primary Survey	Primary Survey: initial phase of the patient assessment model. The paramedic performs a prioritized check to find and intervene to control immediately life- and/or limb-threatening situations.
Principles of Management	Guidelines for the treatment of common injuries or conditions. Principles of management may include the use of protocols (which allow paramedics to perform delegated medical acts).
Protocols	Paramedic practitioners perform delegated medical acts through the use of written protocols. A typical protocol includes the indications (conditions under which a protocol may be initiated), contraindications (conditions under which it should not be initiated), steps in performing the protocol (often in the form of an algorithm), and guidelines that discuss concerns, common issues, or complications in using the protocol.
First responders	Paramedics often work with “first responders” such as police and fire fighters. In addition to their primary function, first responders may have basic emergency medical training and provide basic care until a paramedic crew is on scene. The paramedics will often direct first responders to perform ongoing tasks during a call, such as CPR, helping to control bleeding, or assisting with patient lifts and transfers.
Standardized patients	Actors who are prepared with extensive histories and coached on how to “present” as patients with specific conditions, such as a patient with an extensive cardiac history who portrays a patient having a heart attack or myocardial infarction.
To *manage* a type of call	Used as an integrative term implying the assessment, diagnosis, and treatment of an injury or condition.

ACKNOWLEDGEMENTS

I'm grateful to my supervisor, Don Krug, for encouraging me to enter the program and guiding me through it. Along with Don, my committee members Dan Pratt and Bernie Garrett provided ongoing encouragement, incredible insight, and critical comment. Their feedback and high standards made this a far better document and a great experience.

Over 100 people participated in staging the high fidelity simulations at the New Westminster and Kelowna campuses of the JIBC. This dissertation simply couldn't have been accomplished without the willingness of nine dozen colleagues, friends, family members, students, instructors, and preceptors to give up a day of their lives and let me watch them work together. A wider circle of staff and faculty helped put together the logistics and mechanics required to stage these days. The JIBC's librarians remained helpful, knowledgeable, and remarkably cheerful in the support they continued to provide. And I'm particularly grateful to two presidents, three deans, a program director, and two program coordinators for their ongoing interest, advice, resources, and support of this work. Buried in this mass acknowledgement are several key individuals, Eddy Workhoven, Greg Anderson, Steven Mills, and Bill Maser, who served as variously as partners ("on car"), patrons, exemplars, and audiences (both sympathetic and critical).

I'd also like to acknowledge the Social Sciences and Humanities Research Council for financial support, and the JIBC for both financial and logistical support of this study.

I owe thanks as well my colleagues in Canadian EMS education who inspired me, challenged me, and listened to far too much of what I had to say about our shared passions for patient care and learning. My particular thanks goes to Tim Essington for blazing a path and Walter Tavares for joining me along it.

Many people read portions of this dissertation and provided feedback, suggestions, and corrections. Karen Crosby of Editarians provided invaluable assistance in cleaning up my abuses of the English language and my modifications of APA formatting.

And I'm most grateful to my family: my wife, Karen; my daughter, Joanne; and my son, Craig who helped me through this time and who let me bring this seemingly never-ending project into the midst of our lives. Thanks for being there.

CHAPTER 1: BACKGROUND AND ORIENTATION TO THE STUDY

> Every time the students move from one performance domain to another, whether it's from independent study to the classroom or from simulations to on car, it's like they step off a cliff and fall into an abyss. Some students just need a couple of calls and off they go again. Others flounder and take longer to find their feet. And some never do make the transition. (personal communication with a paramedic instructor, February, 2005)

My research explored a gap separating traditional simulation learning from field practice—a chasm between the comfort and consistency of technical competence and the complexity of professional practice. I explored this space through the lens of developing clinical competence and clinical judgment in the context of high fidelity (HF) simulations involving recruit paramedics at the Justice Institute of British Columbia (JIBC).

The opening quote to this chapter took place during a discussion regarding the experience of students moving from classroom simulations to the practicum (or field) setting. Intuitively, this gap seems a simple pause as students move from one learning domain to another. Yet there is more here. Traditional paramedic programs are based on a conception of learning as progression from acquiring knowledge in the classroom and developing skills in simulation to their integration and application in the practicum. In this view, the practicum is an extension of the simulation lab, or, perhaps, simulations are a subset of field practice. The findings in this study, however, suggest that traditional simulations and the field practicum represent radically different learning environments—nested and overlapping environments sharing significant common elements, but distinct—each with its own sets of roles and expectations, patterns of practice, and methods of assessment that call on different epistemological and ontological conceptions of what constitutes competent practice, what knowledge matters most, and how learning occurs. I argue that the gap is not a semantic distinction but, rather, the tension of learners experiencing technical competence and clinical competence as different ways of knowing.

My research explored this tension in an effort to better understand how learning emerges in immersive HF simulation environments and how that understanding might facilitate the development of clinical judgment in paramedic recruits. This interest was spurred by increasing demands on health educational programs and recent developments in simulation technologies.

Context of the Study

In this study, I sought to better understand the relationships between conceptions of curriculum and the use of simulations in fostering complex forms of learning in paramedic education settings. The study was conducted with paramedic students from the JIBC, a public post-secondary educational institute in western Canada. The study was situated within a set of overlapping contexts: paramedicine, with its twin roots in the emergency services and health care; simulation as a form of created learning activity calling upon experiential learning theory; competence and clinical judgment in relationship to developing expertise within a professional domain; the use of educational technologies; and the study of curriculum in professional health education.

The Practical Problem: HFS as a Link Between Classroom and Field Practice

Paramedic educators, like educators from other health disciplines, are challenged to produce greater numbers of graduates who are better prepared to function in an evolving and increasingly complex health care system (Bledsoe, Porter, Cherry, & Clayden, 2005; Garrett, Tench, van der Wal, & Fretier, 2007). The practicum environment, which has long been a critical link between simulation-based learning and field practice in the health disciplines, is increasingly stressed in attempting to accommodate these rising demands and expectations (British Columbia Academic Health Council, 2005; Garrett, Tench, et al., 2007; Qayumi et al., 2012).

At the same time, the simulation environment in the health disciplines has become

increasingly enriched through the use of standardized patients, human patient simulators, augmented reality, and virtual environments (Qayumi et al., 2012). High fidelity simulation (HFS) may hold promise as a method for reducing or replacing practicum experiences. Despite significant capital investment in HF simulation infrastructure, however, HF simulation remains an adjunct to, but not a replacement for, practicum placement (Garrett, et al., 2007; Garrett, van der Wal, & Gable, 2007; Qayumi et al., 2012). The practical problem addressed in this study, then, is the presumption that HFS can be used to reduce reliance on practicum placement.

Unchallenged Assumptions: Paramedic Curriculum as Building Blocks

The JIBC's current paramedic programs embody a conception of learning as additive and stable, in which the pedagogic whole is the sum of its parts, and through which learners encounter and master curricular content in a more or less predictable progression. Curricula are envisioned and enacted as closed systems in which learners develop skills, knowledge, and judgment that are applied in, but distinct from, the context in which they will be used. Instruction, assessment, and evaluation focus on supporting learners as they accumulate progressively complicated chains of foundational knowledge and procedural skills. Classroom simulations and the field practicum are seen as linked environments, with the gap but a momentary disturbance as learners move between performance domains.

This conception is embedded in Canadian professional documents such as the 2001 *National Occupational Competency Profile for Paramedics in Canada* (*NOCP*), produced by the Paramedic Association of Canada (PAC). The *NOCP* provides general, specific, and subcompetencies that define paramedic practice in Canada. The *NOCP*'s subcompetencies provide the observable behaviours by which performance is assessed. Knowledge-based criteria define and bound the required performance expectations. Competence is defined as consistent,

un-coached, timely, and accurate performance of the identified skills and procedures (Canadian Medical Association, 2007a). A unique feature of the *NOCP* is its hierarchical categorization of competencies into performance domains: awareness, academic, simulation, clinical (hospital), and practicum (field placement). Learners are expected to acquire foundational knowledge, develop skills in simulation, perform them in the controlled context of a hospital setting, then demonstrate competent performance in a practicum placement.

Taken-for-Granted Conceptions: The Role of Fidelity

The concept that HFS can replicate the field environment arises from taken-for-granted assumptions that increased fidelity is associated with higher order learning outcomes.

Simulation is a key learning activity in the development of technical competence in paramedic education. Learners within the current curriculum encounter a structured series of practice learning activities—simulations and their derivatives—in a simple-to-complex progression. Learners develop simple skills in isolated skill stations. These skills are applied in the context of procedural algorithms (such as a patient assessment process or treatment protocol) through simple scenarios or drills. Next, learners integrate these procedures with diagnostic reasoning and clinical decision making during full-call simulations. Finally, learners apply their knowledge, skills, and judgment in performing actual ambulance calls under the guidance of experienced practitioners (preceptors) in a field practicum or preceptorship.

Two related concepts appear to move in parallel in this process. Both the complexity of the procedural activities and the fidelity of the created learning environments (and, in particular, physiological and procedural fidelity) increase as learners move from skills stations towards the field setting. Thus, the literature often associates increased fidelity with more sophisticated or higher-order learning outcomes (for a critical discussion of this assumption, see Beaubien &

Baker, 2004; Dieckmann, Gaba, & Rall, 2007; Norman, Dore, & Grierson, 2012). This perspective, consistent with the instructional design paradigm that supports it, rests on realist ontological assumptions and a conception of learning as the acquisition of discrete and relatively stable skills and knowledge. Bridging learners from the classroom to the field is seen as a matter of performing or practicing in more realistic settings, and thus, increasing fidelity of simulation environment ought to replicate the practicum or field setting.

The Dilemma: Under-theorized Practices

Researchers and educational commentators have noted that although advanced technologies and HF environments are increasingly incorporated into health education programs, understanding of how learning emerges in simulation-based learning environments—the pedagogy of simulation-based learning—is less developed (Beaubien & Baker, 2004; Essington, 2010; Issenberg et al., 2005).

The dilemma, then, is why? Despite increased fidelity of patient presentation (through actors and mannequins) and the physical environment (creating mock hospital wards and operating theatres), HFS is still not seen as a replacement for the practicum. What, then, is different between these two environments? What elements of the field environment are not being incorporated into HF simulation? What is different in how these elements act and interact with each other? How is the experience of participants different during simulations and in the field? In what ways are the roles, expectations, teaching and learning activities, and assessment methods different? What do learners bring to and take away from their experiences, and how does this foster learning?

Point of Entry: Conceptions of Competence and Clinical Judgment

The point of entry for this study involves the concepts of competence and clinical

judgment. Clinical judgment is an odd term—an expression that has multiple meanings and varied uses within the health disciplines. Within educational EMS (Emergency Medical Services or Emergency Medical Systems) literature clinical judgment is framed as the process a paramedic follows in diagnosing and treating a patient (Bledsoe et al., 2005; Caroline, 2010). Clinical judgment is posed as the cognitive process that guides practice; competence is the stamp of acceptable performance (Bledsoe et al., 2005; Caroline, 2010).

Yet, in common conversation between paramedics, the terms competence and clinical judgment are used in ways that are intriguingly at odds with their formal descriptions. In unpublished research conducted at the JIBC, exemplar paramedics tended to use these terms as sliding scales, not binary states. They described practitioners with clinical judgment as those who employed and adapted their processes to the unique needs of a particular call or situation. Clinical judgment, in this sense, is an expression of the practitioner's ability to *see* the environment, *discern* what is important, and *construct* a mental model from which not only to treat the patient's condition, but to *manage* the overall situation. This use is more subjective, more subtle, and more situational. Clinical judgment is used, in effect, as an assessment of expertise within one's professional practice.

Two conceptions of competence are contrasted throughout this study. *Technical competence* is defined as the consistent, independent (un-coached), timely, accurate, and appropriate performance of skills, knowledge, and decision making as outlined by an external authority and assessed through observable behaviours. *Clinical competence* is a more holistic assessment of a practitioner's ability to adapt and integrate procedures and strategies to the unique needs of the moment within the dynamic, social environment of field practice. Where technical competence seeks consistent performance across instances and contexts, clinical

competence highlights the practitioner's ability to discern and adapt to the salient features of a particular situation. Within the context of this study, the gap between the classroom and field practice represents the tension that learners experience between these differing conceptions of technical and clinical competence.

Questions and Goal of the Study

If simulation-based learning environments are to supplement or replace practicum experiences effectively, they must be able to support the development of clinical judgment. Thus, the goals of this study are to explore how learning emerges in HF simulations; to examine the relationships between desired learning outcomes, the concept of fidelity, and the pedagogies of simulation; to explore the use of simulations in fostering the development of clinical judgment; and, finally, to consider the implications of these factors for how we conceive of curriculum, develop simulations, and foster learning in professional education settings.

The central question of this study was, "How does a high fidelity simulation-based learning environment influence the development of clinical competence and clinical judgment in paramedic learners?" The following subquestions inform this central question:

1. What and with whom do learners interact in a high fidelity simulation-based learning environment, and how do they interact with them?
2. How are learners' technical skills, domain knowledge, and practical judgment evident in their decision making, actions, and descriptions of their experiences in high fidelity simulation-based learning environments?
3. How do learners structure and present their experiences, decisions, and actions in a high fidelity simulation-based learning environment (e.g., patient care records, debriefings, reflective activities, interviews)?
4. How do learners perceive and describe their own sense of clinical judgment after high fidelity simulation-based experiences?

Approach

I approached these questions through an interpretivst epistemology, multivocal ontology, considering the learning environment as a complex adaptive system. The existing curriculum is

primarily based on behaviourist and cognitivist perspectives, and within that framework, successfully creates a learning environment in which students achieve technical competence as defined by the *NOCP* (PAC, 2011). However, I argue in Chapter 2 that conceiving of learning environments as open, complex adaptive systems better addresses the development of clinical competence and clinical judgment. Thus, I pose key concepts in this research, such as clinical competence, clinical judgment, learning, and interaction within simulation-based learning environments as complex phenomena.

I used the research question and subquestions in this study to explore the relationships and interactions of participants and selected elements or agents in the simulation-based learning environment. I called upon Kincheloe's and Berry's (2004) concept of multivocal research to examine the concept of clinical judgment through a series of conceptual layers. The initial relationships that I chose to look at in this research included a phenomenological exploration of what and with whom the participants interacted in a simulation-based learning environment; how participants made decisions; how they structured and reported their experiences; a critical analysis of what forms of authority they based their judgments on; and to what extent they considered personal, social, and cultural factors in making patient care decisions. I develop and support the epistemological and ontological orientation and key concepts informing this research in Chapter 2.

Situating Myself as the Researcher

All research is grounded in choice (Doheny-Farina, 1993; Lincoln and Guba, 2003), and many of the choices in this study emerge and are informed by my background. I am intrigued, both as an instructor and a curriculum developer, at the variability in experience of participants within the same simulation. The curricular goal of consistency is constantly thwarted by the

interactions of different mixes of students, actors, and environmental factors despite the articulation of explicit learning goals and outcomes, the use of tightly scripted scenarios, and the rigorous efforts to control for inter-rater variation in assessment and marking. As a curriculum developer and educational administrator, I have been frustrated by the friction between course instructors and field preceptors, by the difference in advice they give students, and by the ever-present tension between the expectations of classroom simulations and practice in the field.

My participation in Canadian efforts to develop paramedicine as a distinct discipline and profession has contributed to several aspects of this study. I have struggled with the emphasis on competency-based processes and documents to describe and prescribe paramedic practice and education, particularly at a time when the practice of prehospital care is emerging from its technical roots as an emergency service towards recognition as an evolving health care profession (Bilecki, 2009; Bowles, 2009). And, along with other Canadian paramedic educators, I have been dismayed by the effect of imposing behaviourist definitions of competence and evaluation onto the practicum environment (Tavares & Mausz, in press). A simulation-based learning environment that fosters the development of clinical judgment must incorporate opportunities for participants to experience and incorporate the unpredictability and interconnectedness of the dynamic factors in the field environment.

Outline of the Dissertation

In this chapter, I presented the question and set the context for this study. Chapter 2 presents a review of literature relevant to the theoretical perspectives that informed this study, conceptions of clinical judgment in paramedic practice, and selected perspectives of experiential learning theory. The chapter develops and articulates working definitions of competence, clinical judgment, simulation, and fidelity. In Chapter 3, I describe the process by which I gathered,

analyzed, interpreted, and represented the findings of the study. Chapter 4 is a descriptive analysis of three cases representing the simulation-based learning environments I encountered in the study and presents the study's initial findings. Chapter 5 provides analysis of these findings through five conceptual categories that represent an emergent understanding of how learning develops in dynamic, interactive, simulation-based environments. In Chapter 6, I further integrate and synthesize the results of the study through a series of integrative themes. The final discussion returns to the starting questions of this study and addresses factors that influence the development of clinical competence and clinical judgment in simulation-based learning environments. I conclude with a discussion of how alternate conceptions of curriculum in professional settings might better inform the creation and use of simulation-based learning environments that foster the emergence of complex learning outcomes.

CHAPTER 2: REVIEW OF THE LITERATURE

The first chapter set the question and provided the context for this study. In this chapter, I review selected literature that presented the theoretical perspectives that informed this study and developed the working definitions for core concepts that influenced its design and unfolding. I start by reviewing selected literature that articulates concepts of complex adaptive systems, and in particular the characteristics of complex phenomena. The second section traces concepts and definitions of competence and clinical judgment from the perspectives of EMS, health, and clinical reasoning literatures. The third section calls upon phenomenological literature on naturalistic decision making, skill acquisition, and reflective practice to develop and enrich a working conception of clinical judgment for the study. The fourth section turns to learning theory, exploring selected perspectives from experiential learning literature as a rich conceptual milieu from which to examine how learning occurs in professional and simulation-based environments. The fifth section integrates and articulates a theoretical approach to simulation-based learning. The chapter concludes by developing working definitions for the core concepts that extend throughout this study.

Complex Phenomena

In this study, I turned to Davis and Sumara's (2006) articulation of complex phenomena in educational contexts to develop definitions of clinical judgment, learning, simulation-based learning environments, and fidelity as complex phenomena characterized by their situatedness, dynamic interactions, and interdependence upon other complex elements and systems. Although behaviourist, cognitivist, and constuctivist approaches have dominated 20th century educational literature, educational researchers and writers are increasingly calling upon concepts of complexity to inform educational practice (Davis & Sumara, 2006; Stanley, 2005). Weaver

(1949, as cited in Stanley, 2005) is credited with defining and distinguishing between simple, complicated, and complex phenomena. Complexity science emerged during the 1950s and 1960s in the study of cybernetics, physics, chaos theory, systems theory, network theory, and non-linear dynamics. Since the 1990s, concepts of complexity have increasingly become common in the social sciences, including sociology, anthropology, and education (Byrne, 1998; Clarke & Collins, 2007).

Educational descriptions of complex phenomena have built on Weaver's (as cited in Stanley, 2005) categorization (Clarke & Collins, 2007; Davis & Sumara, 2006). Fleener (as cited in Doll, Fleener, Trueit, & St. Julien, 2005) introduced three aspects of complexity as useful in educational settings: complex adaptive systems, dissipative structures, and chaos dynamics. Indeed, the language of complex systems is embedded in a diverse range of educational literature, including (but by no means limited to) situated learning (Brown, Collis, & Digluid, 1989), communities of practice (Lave & Wenger, 1991), and distributed cognition (Hollan, Hutchins, & Kirsh, 2000). Doll (1993) called upon Prigogine's (1961) discussion of open and closed systems as an entry point for reconceptualising curriculum as an open, process-oriented system. Kincheloe and Berry (2004) situated their postmodern approach to multivocal educational research as informed by concepts from complexity studies and complex systems.

Davis and Sumara (2006) have been active in bringing concepts from complexity into educational research and practice. Their description of complexity studies rested on a pragmatic epistemology and transdisciplinary approach. They claimed that a complexity-based perspective is still young and "refuses tidy descriptions and unambiguous definitions" (Davis & Sumara, 2006, p. ix) as a discipline, field, or research approach. Rather, complexity studies are characterized by their objects of study (Davis & Sumara, 2006): phenomena that exist between

the limits of analytic linear description and indeterminate chaos (Byrne, 1998). Approaches informed by complexity strive for multivocal perspectives that acknowledge and confront the complexity and interconnectedness of the lived world. These complex phenomena defy traditional linear, analytic analysis and cause-effect relationships (Kincheloe & Berry, 2005).

Complex phenomena are dynamic systems with the ability to transform themselves through interaction with the environment around them (Doll, 1993); they are composed of, and comprise other complex, dynamic systems (Davis & Sumara, 2006); the outcomes of their interactions are unpredictable, although at key points, new, more highly organized patterns of behaviour emerge (Clarke & Collins, 2007; Doll, 1993).

The local stability and global unpredictability of these complex adaptive phenomena, their interaction with both finer and broader levels of organization, and their networked organization serve as conceptual and explanatory models from which to explore the participation and interactions examined in this study.

Characteristics of Complex Phenomena

Davis and Sumara (2006) provided a list of characteristics of complex phenomena:

- Self-organization that arises from the interlinking and co-dependence of its agents or components
- Bottom-up emergence of systems whose capabilities exceed the individual capabilities of its components;
- Short-range relationships between local elements of the system, rather than central control or top-down hierarchies;
- Nested structures or scale free networks in which a complex structure is composed of other complex elements, but also becomes part of other, larger complex systems or phenomena;
- Ambiguously bounded entities that exchanged information, energy, and matter with their surroundings;
- Organizationally closed forms, that are, nevertheless, inherently stable;
- Structure determined in that they adapt to their surroundings to remain viable; and
- Function far-from-equilibrium, in a constant state of change and adaptation. (pp. 5–6)

A core concept in this study is that of the nestedness or embeddedness of complex phenomena. Flyvberg (2001), along with Kincheloe and Berry (2004), noted that an object of study is always embedded in a context and that this context is necessary to the study of the object. Thus, complexity brings to the forefront "the role of the knower in the known, in contrast to the efforts of analytic science to erase any trace of the observer from the observation" (Davis & Sumara, 2006, p. 26).

Davis and Sumara (2006) extended the idea of nestedness to metaphors and conceptions of knowledge and knowing. They stated that popular metaphors of knowledge see the knower's subjective understanding as separate from the objective knowledge from which it is drawn. Concepts of learning associated with transmission models of instruction and building-block conceptions of knowledge construction present learning as acquisition of objective external facts. In this conception, skills that learners acquire early in a program are considered to be stable and remain unchanged as they are applied in increasingly complicated situations throughout their program.

Davis and Sumara (2006), however, presented the learner's subjective understanding as nested or embedded within the larger complex entity of a discipline's body of objective knowledge (see Figure 1). From this view, learning emerges as interaction between the learner and the broader community or domain, seen in metaphors of learning as movement from the periphery of a discipline towards full participation within a community of practice (see, for example, Lave & Wenger, 1991). Davis and Sumara (2006) framed learning as an "ongoing [negotiation] of the perceived boundary between personal knowing and collective knowledge" (p. 27). What is known personally and within the disciplinary collective is further embedded in broader transdisciplinary, social, and cultural constructs.

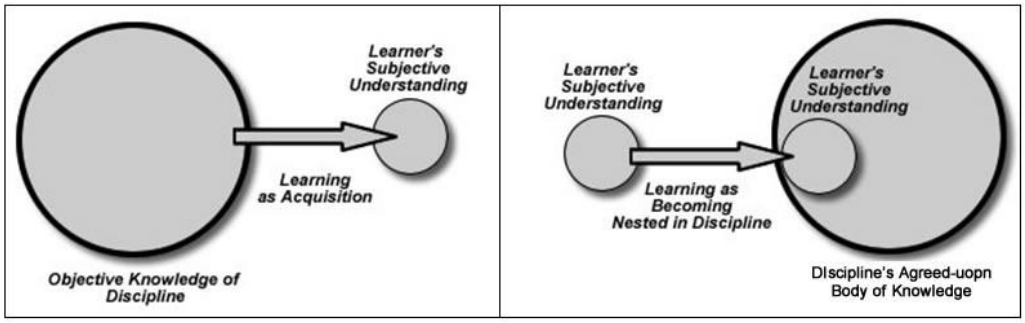

Figure 1. Different ways of knowing.

Contrast of objectivist and complexivist perspectives on the relationship of subjective to objective knowledge of a discipline. Adapted from *Complexity and Education: Inquiries into Learning, Teaching, and Research*, by B. Davis & D. Sumara, 2006, p. 27. Copyright 2006 by Lawrence Erlbaum Associates.

Note that each of these phenomena dynamically interact (complex phenomena are not static, they function far-from-equilibrium), and as such, as the learner functions within a group, those actions change the collective body of knowledge of the discipline as well. From this perspective, prior learning is not stable—it changes as it is used within new situations. Learners must constantly adapt skills and knowledge, and develop their own personal style of practice, as they work with different partners, encounter different contexts, and approach new calls or situations, each with unique needs in-the-moment. These characteristics of complex phenomena, and in particular, that of nested structures and relationships, are employed in this study as a way of conceiving, defining, and relating central terms and concepts in this study.

Conceptualizing Competence and Clinical Judgment

The next section of this chapter reviews selected literature in order to describe, define, and develop conceptions of competence and clinical judgment as used within this study. The following discussion traces the tension between technical and clinical conceptions of competence from the nominal definitions of these terms through their use within specific literature.

Competence

The tension between technical competence and clinical competence is more than a useful construct for examining learners' progression from classroom to field practice. The difference is embedded in common language and competing conceptions of core definitions of terms we use to define and describe competence and clinical judgment.

There are two general sets of nominal definitions for the term *competent*, one derived from a sense of rivalry or competition, and the other from a sense of fitness or adequacy ("Competent," 2013). Several definitions pose competence as a measure of one's performance against external standards, such as "possessing the requisite qualifications [and] adequacy of work; legitimacy of a logical conclusion" ("Competent," 2013, para. 5). There is an objectivist tone in these definitions – an implication that competence involves the application of skills and knowledge towards predefined goals, and a sense that competence is an objective, measurable state. One is not intrinsically competent; one is competent only in comparison with some external standard.

A second set of definitions draws on the sense of coming together, coinciding, or being convenient, apt, or fit. These definitions take a more pragmatic, subjective view, seeing competence as "[s]uitable, adequate, or sufficient, in amount or extent, [or] sufficient . . . fair, moderate, reasonable, enough" ("Competent," 2013, para. 3). The first set of definitions focuses on external observation of one's performance against a set of standards, while the second set emphasize an internal capacity that is situated in a particular sphere or domain of practice.

The term *judgment* is older, entering English as early as the thirteenth century ("Judgment," 2013). The definition that comes closest to paramedic use of the term focuses on the process of judgment as the "pronouncement of a deliberate opinion on a person or thing"

("Judgment," 2013, para. 6). This has a rationalist flavour, citing judgment as "exercising the mind [or] . . .mental apprehension of relationship between two objects of thought [and] . . .a function of the mind" ("Judgment," 2013, para. 6). This sense calls to authority, reason, doctrine, and deduction.

A contrasting set of definitions sets judgment as an attribute or capability—the "ability to form an opinion" ("Judgment," 2013, para. 7). These definitions have a sense of judgment as more than the application of reason and refer to judgment as a critical faculty, employing discretion, discernment, wisdom, and understanding to reach just, righteous, and equitable decisions. While the sense of judgment as a reasoned process is here, so too is recognition that the forming of just opinions is set within a wider set of factors. Judgment involves discernment and the weighing of options, not just the act of comparing them to preset standards. As with competence, judgment can call upon two competing conceptions; judgment may be either a function that draws on external authority to arrive at conclusions dispassionately and objectively or as an internal faculty of discernment that is yet inextricably bound to the environment one functions in.

In paramedic practice, the term *clinical* is used to distinguish field practice from more abstract or academic settings. Again, however, the term clinical has multiple meanings which speak to learners' experience in transitioning from classroom to field practice. The first definition draws from early medical literature "pertaining to the sick-bed, [specifically] to that of indoor hospital patients; used in connexion with the practical instruction given to medical student at the sick-beds in hospitals" ("Clinical," 2013, para. 1). A second definition refers to clinical baptism as a rite given at the sick-bed to one who is imminent danger of dying. These definitions embed and define clinical performance through its context of practice. The third sense of clinical is

more recent, abstracting clinical to represent "coldly detached and dispassionate, like a medical report or examination; diagnostic or therapeutic… treating a subject-matter as if it were a case of disease, especially with close attention to detail" ("Clinical," 2013, para. 3). This definition stands in stark contrast to the situated sense that the previous definitions carried. The focus has shifted from the location (sick-bed) and state of the person (hospitalized or near death) to an abstraction of the disease process. In this sense, oddly, clinical explicitly removes the context of the situation to focus on its diagnostic or therapeutic considerations.

Each of these terms—competence, judgment, and clinical—may be framed to either draw on rationalistic and objectivist performance that is judged by comparison to external standards, or as value-laden activities defined by and situated within their context of performance. The former rests comfortably with current cognitivist curriculum structures, expectations, and evaluation; the latter opens up space for examining the relationships between practitioners and their operational environment. Within this study, these contrasting conceptions are distinguished by the terms *technical competence* and *clinical competence*.

Drawing upon terminology from the *NOCP* (CMA, 2007a), *technical competence* is defined in this study as the consistent, independent (un-coached), timely, accurate, and appropriate performance of skills, knowledge, and decision making as outlined by an external authority and assessed through observable behaviours. I conceive *clinical competence*, however, as a more social construct involving an ongoing negotiation between what the learner *knows* and *can do* with a series of overlapping relationships and expectations between the learner, her or his partner, the patient, family and bystanders, situational and environmental factors, operational guidelines and protocols, the community of practice, and social and cultural expectations. *Clinical competence* is defined and distinguished from *technical competence* as the ability of the

paramedic to apply, adapt, and integrate procedures and strategies within the dynamic, social environment of field practice.

In this same sense, I pose *clinical judgment* as a complex phenomenon—a context-laden activity in which the paramedic considers the patient, protocol, procedures, personnel, past practice, and best practice. The following section explores concepts of clinical judgment with the goal of developing a working definition of clinical judgment for this study.

Towards a Definition of Clinical Judgment in EMS

The term *clinical judgment* is variously used in health disciplines as a product of clinical reasoning, a diagnostic process, as an organizing concept, and a component of larger concepts. Norman (2005) outlined the progression of research involving medical expertise, conceiving and articulating *clinical reasoning*—and its synonym *clinical judgment*—initially as a generic and abstract cognitive decision making model, then as the development of expert knowledge, and more recently as the mental schema underlying multiple cognitive problem-solving strategies. A 2007 doctoral study in medicine defined clinical judgment and clinical reasoning as components of clinical competence (Baig, 2007). Studies in nursing have used clinical judgment as a global construct supported through clinical reasoning and critical thinking (Ferguson, 2006; Lasater, 2005; Ruggenberg, 2008). Indeed, the varied literature encountered in this literature review placed clinical judgment in a nest of overlapping and sometimes contradictory terms and constructs. These studies looked at issues of expertise and clinical judgment from different perspectives, with different goals, and called upon various research traditions and methods which, in turn, rested upon different views of what constitutes knowledge and how we come to know. Each provided a different snapshot or view that explored some facet of overall professional practice. Individually these views seem inadequate to informing the task of

understanding the tension between technical competence and professional practice. Together, however, each helps build a more comprehensive view clinical judgment and how it develops.

Clinical judgment in EMS. There is little research into clinical judgment in an EMS setting. EMS is an emerging field, yet to define itself and establish a solid foundation of academic literature (Jensen et al., 2012). Academic literature on clinical judgment in EMS has often examined whether paramedics possessed the clinical judgment to perform advanced procedures (Atherton & Johnson, 1993; Canadian Patient Safety Institute, 2010; Hall et al., 2005; Jones & Wollard, 2003; Leblanc, Macdonald, McArthur, King, & Lepine, 2005; Long, 2005; Pitt, 2002; Snooks, Halter, Lees-Mlanga, Koenig, & Miller, 2000), or the efficacy of initiating new treatments or procedures in the field (Davis, Cobaugh, Leahey, & Wax, 1999; Eckstein & Suyehara, 2002; Eo et al., 2003; Sayre, White, Brown, McHenry, & National EMS Research Agenda Writing Team, 2002; Woollard, Smith, & Elwood, 2001). These studies referred to clinical judgment as a characteristic of paramedics but did not explore its definitions or development.

The term *clinical judgment* is also absent in formal professional literature in Canadian EMS. The *NOCP* does not explicitly use the terms clinical competence or clinical judgment. Clinical reasoning and clinical decision making are also absent as terms within the *NOCP*. However, the process of clinical reasoning is embedded as a series of steps that constitute assessing and providing care to patients with specific injuries or conditions.

Clinical judgment, in EMS education literature, is the process by which a paramedic assesses the scene, develops a set of differential diagnoses, and modifies further assessment to reach a provisional diagnosis which is the basis for the development of an appropriate treatment plan. Current North American EMS texts define clinical judgment as a synonym for clinical

reasoning, employing “the use of knowledge and experience to diagnose patients and plan their treatment” (Bledsoe et al., 2005, p. 437). Patient assessment—the EMS umbrella term for clinical reasoning—is a rich, iterative process first learned as a procedural method, then used as a cognitive framework for deductively integrating pathophysiology and principles of management, and finally as an inductive, inquiry-based problem-solving process in field assessment (Bledsoe et al., 2005). Within this framework, clinical judgment is expressed and assessed as an application of the medical clinical reasoning process set within behaviourist and cognitivist educational constructs. The learner’s expected performance is described as a series of layered, hierarchical procedures and assessed through the use of criteria-referenced checklists. A variety of mnemonics and visual devices are used to ensure that learners can effectively remember the clinical decision-making process, then employ it in simulations and the field. The starting point for a working definition of clinical judgment for paramedics, then, is that it involves a process and procedure for patient assessment and decision making.

Modern EMS emerged from advances in trauma care and cardiac resuscitation. Thus, core concepts of patient assessment and management are firmly embedded in medical perspectives and practice. The following sections extend this definition by exploring concepts from health education.

Clinical judgment in physician education. Clinical judgment is most thoroughly explored within a rich and growing body of literature describing medical expertise. A variety of terms have emerged to describe expertise in clinical practice, including clinical judgment, diagnostic reasoning, and critical thinking (Moulton, Regher, Mylopoulos, & McRae, 2007), and clinical reasoning, problem-solving, decision making, and judgment (Norman, 2005). This literature has generally been set within a cognitive psychology paradigm (Mypolous & Regher,

2007; Norman, 2005), has called upon experimental and quasi-experimental methods (Mypolous & Regher, 2007) and has examined clinical reasoning as an overarching approach to patient assessment (Bowen, 2006; Eva, 2004), involving the use of two general strategies (Eva, 2004), and an impressive and flexible set of specific processes and cognitive constructs (Mypolous & Regher, 2007; see Figure 2).

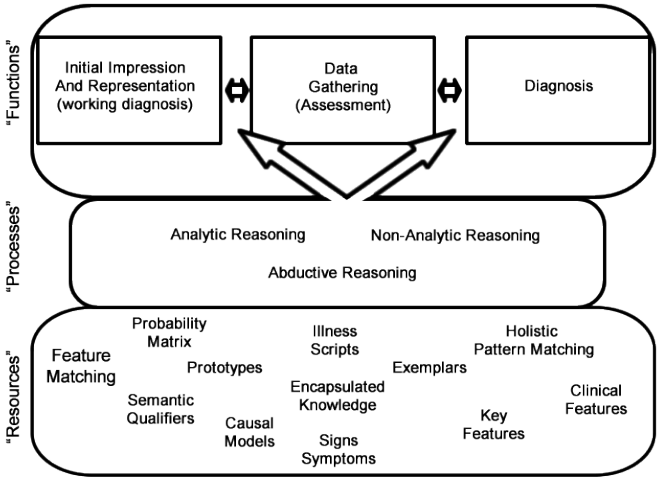

Figure 2. Functions, processes, and resources of clinical reasoning.

At its most general level, clinical reasoning involves a series of functions or activities that occur in a more-or-less predictable pattern. The practitioner encounters a patient, forms an initial impression or representation of the case, gathers data to support or discount potential causes of the patient's presentation, and arrives at a diagnosis.

Clinical reasoning is supported through the use of several analytic, non-analytic, and abductive processes and strategies (Ward & Haig, 2011). Hypothetico-deductive processes, credited to Elstein, Shulman, and Sprafka (1978) and described in the research (see, for example, Ericsson, 2007; Norman, 2005), represented an analytic approach wherein the physician identifies a series of potential diagnoses, then gathers patient data to rule in or rule out these

options. This process relies on an expert body of clinical science knowledge allowing practitioners to identify key signs, symptoms, and features of a situation, and some form of probability analysis to determine the most likely cause of the patient's presentation (Eva, 2004). Non-analytic processes involve the non-conscious generation of diagnoses through pattern recognition or recollection of prior, similar cases (Eva, 2004; Norman, 2005; Norman, Young, & Brooks, 2007). Non-analytic processes rely on the ability of the practitioner to create and maintain categories of cases in memory. Patel, Arocha, and Zhang (2004) described abductive logic as a cyclical process of generating and testing diagnostic hypotheses.

Diagnostic or clinical reasoning requires a foundation of knowledge in clinical sciences and a body of experiential cases. Norman (2005) stated that expertise involves the development of an extensive, multidimensional, relational database, what Myopolous and Regher (2007) referred to as a "set of impressively rich and well organized resources and processes" (p. 1159) that support clinical reasoning. Examples include illness scripts[1] (Schmidt and Rikers, 2007), prototypes and exemplar cases[2] (Norman et al., 2007), and semantic qualifiers[3] (Bordage, 2007).

These resources support both analytic and non-analytic processes. Strategies such as

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[1] Schmidt and Rikers (2007) focused on the role of experience in the development of memory structures in physicians. Learners initially develop rich causal models linking pathophysiology and clinical presentation. With time and experience, they restructure or "encapsulate" this basic bioscience knowledge into simplified causal models or shortcuts used to explain their patients' presentation. Further experience with specific cases leads them to create "illness scripts" that include "a wealth of clinically relevant information about the enabling conditions of disease" (Schmidt & Rikers, 2007, p. 1135). As the physician continues in practice, specific cases that call upon an illness script become instantiated and leave an episodic or narrative trace that may be called upon for helping to diagnose future cases.

[2] Prototype theory "assumes that a person's experience with individual exemplars is averaged into a prototype of the category that contains most of the critical features of the category" (Norman, 2007, p. 1141). New instances (or, in diagnosis, the case in question) are classified into the existing category with which it has the most features in common. By contrast, exemplar theory suggests that over time, practitioners build a mental base of exemplar situations or cases through experience. New cases are categorized by "an unconscious similarity match with a particular prior example of the category" (Norman, 2007. p. 1141).

[3] One of the key functions of clinical diagnosis is the translation of the patient's story into a set of terms and constructs that facilitates clinical reasoning. Experienced clinicians, Bordage noted, tend to identify and frame key features of the patient's presentation into medical terms set within a series of opposed diagnostic categories, such as chronic:acute, gradual:sudden onset, or distal:proximal. This framing allows the practitioner to restate the patient's presenting complaint as a diagnostic picture that is more easily categorized.

translating the patient's story to diagnostic language, determining the key features in a patient's presentation, and recognizing situations as instances of previous exemplar cases help develop initial hypotheses (competing potential diagnoses to be differentiated). Over time, practitioners encapsulate basic science knowledge and experience with cases to develop illness scripts and prototypical cases in memory to support more holistic pattern recognition for making diagnoses.

Several researchers seek to synthesize the use of analytic and non-analytic approaches within a larger process of clinical reasoning: with experience, diagnosticians tend to follow non-analytic approaches for routine cases, but revert to more mixed and analytic strategies when presented with novel or complicated cases (see, for example, Eva, Hatala, LeBlanc, & Brooks, 2007; Moulton et al., 2007; Patel et al., 2004). Eva (2004) noted that both analytic and non-analytic processes are involved interactively in hypothesis generation; Bowen (2006) compared the diagnostic journeys of a novice and resident practitioner to relate these processes and resources into a model of diagnostic clinical reasoning. Patel et al. (2004) described abductive reasoning as a cyclical blend of inductive and deductive reasoning employed throughout the process of diagnosis.

Two features of this model are of interest to this study. First, as Norman (2005) noted, "'expert clinical reasoning' really amounts to expert diagnostic reasoning, usually in internal medicine" (p. 425). The patient's personal history, social setting, and cultural background are either ignored or considered as data only if relevant to obtaining a diagnosis, and the model does not consider broader concerns of developing and implementing treatment plans, dealing with situational factors, or working within a team environment. Second, however, this model of clinical reasoning does provide rich descriptions of how medical practitioners approach diagnoses. These processes and strategies provide observable markers which may indicate the

use of clinical reasoning within the practitioner.

Existing models of patient assessment in EMS provide procedural models for practitioners to use when managing a call. The medical expertise literature has enriched this view by providing windows into the processes and strategies that practitioners use when performing the diagnostic functions of clinical judgment. EMS and other health disciplines, however, often deal with more than the patient's presenting problem. The following section explores clinical judgment from the perspective of other health disciplines.

Clinical judgment and critical thinking in health professions. Research from medical education in clinical reasoning has served as a starting point for research into clinical judgment and clinical reasoning process in professional health programs including advanced nursing practice (Bald, 2006), community-based nursing (Bryans & McIntosh, 2007; Carr, 2004), physical therapy (Edwards, Jones, Carr, Braimack-Mayer, & Jensen, 2004), physiotherapy (Edwards, Jones, Higgs, Trede, & Jensen, 2004), and speech therapy (Hoben, Varley, & Cox, 2007). However, many of these studies adapted the clinical reasoning process to function within the broader context of practice in their setting (Nikopoulou-Smyrni & Nikopoulos, 2007). Research from the medical expertise literature has tended to focus on immediate diagnosis from the perspective of the physician. Other health disciplines tend to work with diagnosed patients during treatment, recovery, and rehabilitation over a substantial period of time. The clinical reasoning literature has left broader conceptions of ongoing patient care—which are the focus of many health disciplines—unexamined.

The development of clinical competence and expertise has been studied in a nursing context by Patricia Benner (2001) and her colleagues (Benner, Tanner, & Chesla, 2009). Benner, drawing on Dreyfus and Dreyfus' (1986) phenomenological work on skill acquisition (see the

following section), examined the development of clinical knowledge and set clinical judgment as a more holistic construct. Within Benner's model, cognitive strategies and educational interventions prepare a novice nurse to enter practice as an advanced beginner. What is particularly interesting in Benner's work is the notion that the context of practice is an element of expertise. The development of expertise requires immersion and experience within a particular setting. Benner noted that it may take two years for practitioners to become proficient and expert at practice within a particular setting. When an expert practitioner moves into a different setting, it will again take time, experience, and deliberate or reflective practice to become expert within this new context.

Another strand of nursing literature has posed critical thinking as an integrative concept that entails characteristics (attitudes/behaviours), experiential and theoretical intellectual skills, technical skills, and interpersonal skills. Alfaro-LeFevre (2004), for example, defined critical thinking as the "ability to focus your thinking to get the results you need" (p. 5). She acknowledged the subjectivity of assessing critical thinking and situated critical thinking and clinical judgment within a broad set of relationships including the nursing process, scientific method, patient, family and community needs, professional standards, and ethical considerations.

Clinical Judgment as More Than Clinical Reasoning

In the previous section, I explored conceptions of clinical judgment from EMS and health education perspectives. Literature from EMS and clinical reasoning has tended to frame clinical judgment as a diagnostic process focused on patient assessment. What is interesting in the broader health education literature is that clinical judgment, critical thinking, and clinical reasoning are posed as constituent intellectual skills within a broader conception of professional expertise. Viewing clinical judgment as a synonym for clinical reasoning is both narrow and

restrictive, reducing field practice to the technical application of a generic process that differs little between novice and expert practitioners. The health education view of expertise, however, resonates better with paramedics' everyday use of the term *clinical judgment*. A broader conception of clinical judgment moves the curricular end point or goal beyond competence and fosters the development of proficiency and expertise. The following section calls upon phenomenological views of naturalistic decision making, skill acquisition, and professional expertise to further develop the concept of clinical judgment in paramedicine.

Phenomenological Views of Developing Expertise

In this study, I posed field practice as a site of ongoing interaction between multiple participants and a dynamic environment. The processes of clinical reasoning and patient management are important, but they are not the only aspects of professional practice. Viewing clinical judgment as expertise opens a space for exploring the development of practitioners' ability to function within the complex milieu of field practice.

Norman (2005) noted that much of the research in medical expertise has been situated in cognitive and clinical psychology. Benner et al. (2009) and other researchers in clinical reasoning (see, for example, Mylopoulos & Regher, 2007) have drawn on more phenomenological approaches to better consider how practitioners make decisions and develop expertise. The following section examines three concepts drawn from phenomenological inquiry: Klein's (1997) naturalistic decision making (NDM), the Dreyfus' (1986) model of skill acquisition, and Schön's (1983) description of professional practice.

Klein: Naturalistic Decision Making

NDM emerged from decision making literature as a separate strand of research in the late 1980s, calling upon a phenomenological exploration of "the way that people use their experience

to make decisions in field settings" (Zsambok, 1997, p. 3). Mainstream research in clinical reasoning and decision making focused on analytic processes from the perspective of clinical psychology (Norman, 2005; Zsambok, 1997). As Zsambok (1997) noted, decision making research used experimental methods to assess artificial tasks that did "not take into account effects of most contextual factors that accompany decision making in real-world settings, nor [did] they adequately model the adaptive characteristics of real-world behavior" (p. 4).

In contrast to the hypothetical-deductive model of analytic reasoning, NDM research has indicated that experienced practitioners tend to size up a situation, creating an explanatory mental model based on previous similar situations, and then choose a course of action that will suffice to meet the unique needs of the moment (Klein, 1997, 2009). Klein (1997) described two diagnostic strategies: feature matching and story building. Practitioners most commonly use feature matching to compare key features of the current situation to previously encountered cases. Practitioners also use story building as a type of mental simulation used to create causal explanations for the features of the current situation. This story can be "run forwards [to project possible courses of action] or look backwards in time as a way of making sense of events and observations" (Klein, 1997, p. 290).

Two aspects of NDM are particularly relevant to clinical judgment in paramedicine. NDM does not focus on decision making in terms of memory, attention, or cognitive processes. NDM describes what Dreyfus (as cited in Zsambok & Klein, 1997) referred to as "levels of skilled response" (p. 27) for sizing up situations characterized by "time pressure, ambiguous information, ill-defined goals, and changing conditions" (Klein, 1997, p. 285). Klein (1997) noted that NDM focused on "(a) experienced agents, working in complex, uncertain conditions, who face (b) personal consequences for their actions. [NDM] (c) tries to describe rather than

prescribe, and (d) it addresses situation awareness and problem-solving as part of the decision making process" (p. 287). In other words, NDM takes a phenomenological approach to examining decision making within a particular set of circumstances.

A second important feature of NDM is its focus on context, environment, and events. Analytic reasoning isolates key features of a situation, compares them to prototypical cases, and selects the best available option. Clinical experiments exploring diagnostic reasoning are designed to control for context (Norman, 2005). NDM, in contrast, recognizes that the overall context of practice is a central feature of decision making and problem solving. NDM research in firefighting, army and navy command and control, commercial flight control, and nursing in intensive care settings has focused on ongoing decisions that are embedded in the unfolding of events (Klein, 1997). Models of clinical reasoning, while iterative and ongoing, focus on diagnosis and either do not include non-patient care considerations or consider them as complications.

While clinical reasoning is a central aspect of clinical judgment in paramedicine, overall management of a call involves an overlapping set of complicating factors that quite comfortably fit into Klein's (2008) description of NDM settings. Within this conception, clinical reasoning and diagnosis become part of the series of ongoing decisions that practitioners engage in during overall participation in the call. The practitioner must also determine what sources of information to consider in any particular call, and how to interact with family and bystanders, work within an interprofessional setting involving paramedics and other responders, choose and adapt equipment to the particular needs of the environment, and make decisions about when, where, and how to transport the patient.

NDM extends conceptions of clinical judgment by describing decision making within

complex, unpredictable environments. Moulton et al. (2007) called upon the phenomenological work of Schön (1983) and Dreyfus and Dreyfus (1986) to examine how expertise develops. These concepts are further explored in the following sections of this review.

Dreyfus and Dreyfus: Development of Expertise

Herbert and Stuart Dreyfus (1986) presented a five-stage model of skill acquisition that has been used as a basis for studying the development of expertise in the military (Dreyfus & Dreyfus, 1986), nursing (Benner et al., 2009) and medicine (Moulton et al., 2007). The model, refined and represented by Herbert Dreyfus (2001) outlines five stages: novice, advanced beginner, competent performer, proficient performer, and finally, expertise. The learners' performance changes along two lines—the ways in which decisions are made and the importance of context to that decision making. Novices learn context-independent rules for performing specific procedures. As they progress to the advanced beginner stage, they begin to recognize situational aspects and develop principles or maxims for dealing with common situations. Competent performers recognize, with more experience, the salient features of various situations and develop customized plans by choosing between various options for action. Over time, proficient performers intuitively recognize a situation as similar to various prior examples. They discriminate between salient features of potentially conflicting interpretations of the situation and choose or develop a plan that will work in this situation. Finally, expertise develops as the learner acquires a vast repertoire of situations and plans. These situations and plans become associated with emergent themes and categories which often are based on subtle and nuanced features of the cases (see Table 1).

Table 1. Dreyfus' (2001) model of skill acquisition.

Elements or Level	Definition or description	EMS relevant example
Novice		
Context free features	Elements of a situation that can be recognized without previous experience in the task domain	Blood pressure reading: hypotension defined as a blood pressure below 90/60.
Rules	Context independent rules based on context-free features	If blood pressure is below 90 mmHg systolic, do not administer nitroglycerine.
Advanced beginner		
Situational Aspects	Features of a situation are meaningful within a specific context; requires some experience to distinguish aspects from features.	Pallor (pale, cool, clammy skin), which may indicate shock with a history of trauma, or may indicate fright or anxiety in an emotionally charged environment.
Principles/ Maxims	Procedures based on both situational aspects and non-contextual features; requires some understanding and experience to apply.	Position hypotensive patients supine unless this might aggravate other conditions such as shortness of breath.
Competence		
Aspects with importance - salience	Number of relevant factors becomes overwhelming, and practitioner must determine which are most salient or important features of a particular situation.	An elderly male with a cardiac history who complains of sharp shooting pain in his left arm may have a musculoskeletal injury or a cardiac episode. Must decide which is more salient—the description of the pain (MS) or age and cardiac history (cardiac)
Proficiency		
Situational discriminations	Intuitive recognition of situation and identification of salient features based on multiple past similar experiences.	A pedestrian struck by a car; single long-bone fracture, but on the pavement during rush hour in the cold with light rain. Practitioner must consider nature and mechanism of injury, environmental factors, and physical safety to determine whether to transport immediately or assess and stabilize the fractures to prevent aggravating the injuries.
Decide based on salience	Must choose between multiple acceptable options, based on discrimination between salient features. May adapt principles to meet conflicting salient features.	Either treat the patient as stable and splint before moving *or* choose to treat the patient as unstable with minimum stabilization on scene, with further assessment and splinting once patient is in ambulance. Either is acceptable and defendable.

Continued

Table 1 (continued)

Elements or Level	Definition or description	EMS relevant example
Expertise		
Vast repertoire of intuitive perspectives	Intuitive recognition of situations and appropriate plans/perspectives based on a "bank" of previous experiences	Function of experience, either in the field or in simulation. Make decisions based on similarity of present case to successfully managed prior instances.
Subtle and refined discriminations	Distinguishing of subclasses of types of experiences based on experience.	Discussion based on diagnostic and situational categories rather than body system or mechanism of injury; preceptor where patient is abusive, who intuitively recognizes potential for violence.
Intuitively appropriate action	Immediate, intuitive, situational response.	Preceptor in above situation who, without apparent thought, intervenes to ensure scene safety by cuing police officers to situation, positioning himself to block if patient starts kicking, and eventually intervenes to take over assessment of the patient.

Two aspects of this model are of interest to conceptions of clinical judgment: expertise is posed as an increasing awareness of context, and judgment involves personal choice between alternative acceptable interpretations of a situation. Within the Dreyfus (2001) model, expertise develops with time, experience, and the ability to both intuitively recognize, immediately choose, and then adapt actions to meet the requirements of a specific situation. In contrast to the pursuit of consistency which characterizes technical competence, expertise is situational, adaptive, and intuitive. Indeed, a technically competent practitioner (consistent, context-independent performance) would be considered an advanced beginner in the Dreyfus (2001) scheme.

Judgment, according to Dreyfus (2001), is a function of choice: the expert practitioner—one with well-developed clinical judgment—compares, contrasts, and selects an interpretation of the situation from which to recall solutions and actions taken in prior similar episodes and develop a customized plan of action for managing the current condition. Clinical judgment framed as expertise in the Dreyfus (2001)model, then, requires experience and performance

within context to develop the vast repertoire of cases from which to make judgments and choices.

Schön: The Gap between Technical Rationality and Professional Practice

The final phenomenological approach considered in this review is Donald Schön's (1983, 1987) work on reflective practice and professional expertise. Schön's work spoke directly to the distinction between technical and clinical competence, contrasting traditional approaches grounded in what he terms a technical rationalist approach with a view of professional decision making as a process of discernment and adaptation.

Schön (1983) described traditional views of professional education as a hierarchical progression from basic science through applied science to the training in clinical skills. Schön contrasted this view with his vision of professional knowledge based on reflective practice. Technical rationality viewed professional performance as "instrumental problem solving made rigorous by the application of scientific theory and technique" (Schön, 1983, p. 21).

> The application of basic science yields applied science. Applied science yields diagnostic and problem-solving techniques which are applied in turn to the actual delivery of services. The order of application is also an order of derivation and dependence… the more basic and general the knowledge, the higher the status of its producer." (Schön, 1983, p. 24)

From the perspective of technical rationality, the goal of education in the professions is technical competence, defined as context-independent practice based on generalized knowledge. Professional practice, for technical rationalists, focuses on problem-solving. Practitioners identify the key characteristics of a situation and apply the appropriate principle. The mark of the technically competent professional is the acquisition of a large, bounded, unique body of specialized knowledge and the application of standardized principles and guidelines (Schön, 1983).

Schön (1983), however, noted that professional practice, in practice, is less concerned with clearly defined problems that can be solved by generalized principles than it is with "phenomena – complexity, uncertainty, instability, uniqueness, and value-conflict—which do not fit the model of Technical Rationality" (p. 39). Schön's (1983) view of expertise in professional practice focused not on problem solving, but on problem framing: "the process by which we define the decisions to be made, the ends to be achieved, the means which may be chosen" (p. 40). Professional practice, he claimed, is the domain of interpreting a problematic situation when "interactively, we name the things to which we will attend, and frame the context in which we will attend to them" (1983, p. 40). For Schön (1983), expertise is found not in the technical problems of the highlands, as claimed by technical rationality, but rather in the messy swamps of the lowlands, where the practitioner must deal with confusing questions that defy technical solution.

Thus, for Schön (1983), as for Dreyfus (2001), the development of professional expertise is an increasing awareness of the context of practice and the ability to choose between an indeterminate number of potentially acceptable options to problems that are difficult to categorize. While Dreyfus (2001) presented the development of expertise as an unbroken progression, Schön (1983) referred to "a gap between professional knowledge and the demands of real world practice" (p. 45).

Development of Expertise Summary: Clinical Judgment as a Complex Phenomena

Klein (1997), Schön (1983), and Dreyfus (2001) presented the development of expertise and professional practice as adaptive processes that involve discerning and attending to nuance, identifying salient aspects of a situation, and developing a response that meets the needs of the moment. This characterization of expertise resonates with the conception of field practice and

clinical judgment as complex phenomena. And the concepts of nestedness, local interactions, and dynamism are useful for exploring both the functioning and development of clinical judgment.

Clinical competence is an indicator of how well a practitioner can function in this dynamic, unpredictable milieu. And *clinical judgment* involves the ability to discern and consider and incorporate these relationships. In this study, then, I define *clinical judgment* as an integrative concept of holistic professional practice, bringing together technical performance, domain knowledge, and practical judgment to allow the practitioner to see beyond the immediate presentation of the patient—to discern what is important in any particular situation and to make decisions based on broader personal, professional, social, and cultural contexts (see Figure 3). I pose the *development of clinical judgment* as an emergent process characterized by the learner/practitioner's increasing awareness of and ability to incorporate an increasingly complex set of contextual factors and relationships into his or her decisions and (inter)actions.

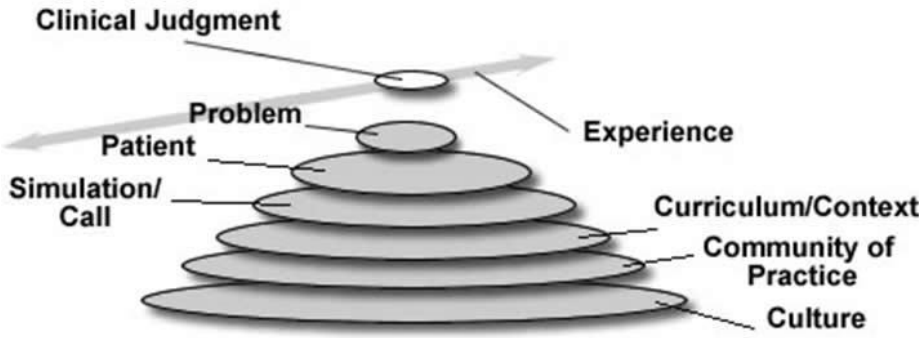

Figure 3. Nested relationships of clinical judgment considered in this study.

Current Paramedic Education Programs

Paramedic practice blends an intriguing set of applied capabilities including knowledge of clinical sciences, psychomotor skills, interpersonal interaction, and adaptive problem solving. Traditional training programs, based on classic instructional systems design models, focus on the development of knowledge, skills, and attitude. But, as developed in the previous sections, expert

performance is as much about adaptation and creation as it is memory and skill; more about discernment and judgment than values and attitude.

In the following sections, I describe the development of EMS education and its roots in behaviourist and cognitivist learning paradigms, then call upon Fenwick's (2003) exploration of several experiential learning perspectives that are relevant to the conceptions of clinical judgment and expertise in this study.

Paramedic Training and Education: A Cognitivist Approach

EMS is a relatively young discipline. Modern EMS emerged in the 1960s through the extension of lessons learned in military trauma management to the civilian setting, and the application, at the patient's side, of CPR and advanced cardiac life support procedures previously available only in the operating theatre or intensive care unit. Early paramedic services relied on emergency medical technicians who functioned under direct supervision of physicians (by telephone and telemetry) or through written protocols. Training tended to focus on procedural skills with little theory (Bledsoe et al., 2005). The paramedic was both legally and functionally an extension of the physician, and thus paramedic training was influenced by structures and concepts drawn from medical education.

Early ambulance services developed into integrated EMS that now include layered levels of response and deeper integration with the overall medical system (Bledsoe et al., 2005; Caroline, 2010; PAC, 2001). Advancing technology and evolving medical practice have led to increased expectations and a vastly expanded scope of practice for paramedics. Paramedic education has evolved from in-house, ad hoc training programs to a series of linked courses and programs leading from initial certification, advanced practice, and continuing education to undergraduate diploma and degree programs in prehospital care, such as the Diploma in Health

Sciences (EMS) offered by the JIBC (n.d.) and the Bachelor of Clinical Practice (Paramedic) at Charles Stuart University (2013).

The curriculum of paramedic education has grown in depth, breadth, complexity, and structure, but retains a goal of technical competence as its end point. While early emergency medical technician courses focused on skills and procedures, the development of advanced life support paramedics led to broader, richer programs with a stronger foundation of clinical theory. These programs adopted curriculum formats based on traditional medical education models, with an early emphasis on didactic (theory) learning, followed by extended practicum placement. Paramedics develop domain specific knowledge from which are derived general principles of management that are then applied in the clinical setting. This structure mirrors traditional professional curricula: basic science, leading to applied science, followed by development of clinical skills (Doll, 1993; Fenwick, 2003; Schön, 1983). This format, claimed Schön (1983), rests on foundations of technical rationality and seeks, as its goal, technical competence in the form of consistent, context-independent performance.

Current programs employ a blend of mastery learning and cognitivist learning strategies. The JIBC developed the current Primary Care Paramedic (PCP) program following a classic instructional design process (see, for example Dick & Carey, 1985), performing an analysis of the *NOCP* (PAC, 2001), industry, and practitioner needs, then sorting the results through the lens of the JIBC's curriculum model to create an objective hierarchy, specify evaluation points and tools, establish learning and instructional strategies, and develop program materials.

A cognitivist approach is employed in the pedagogic construction of the program. Content is carefully sequenced in a simple-to-complex, building block structure. The Patient Assessment Model (based on the analytic process of clinical reasoning) serves as both the

procedural framework for skill development and a cognitive framework for organizing and learning pathophysiology, diagnostic features, and the principles of management of classic presentations of common injuries and illnesses. The program makes liberal use of procedural guides, graphic organizers, and mnemonics to establish common patterns of practice and build mental pictures of how common illnesses and injuries commonly present and are typically managed. The program follows a recursive approach in which new content is related to the central theme, gradually adding new knowledge and skills while reinforcing previously mastered content.

The program employs a staged set of learning activities employing a Mastery Learning model (Hunter, 1994) based on behaviourist and cognitivist learning perspectives. Skills and procedures are first mastered in skill stations, then chained and contextualized in drills and segmented calls or short simulations. Learners next integrate previously learned assessment and treatment procedures in the performance of complete simulated ambulance calls. Performance is guided and assessed through mastery checklists[4] that focus on observable behaviours. Instructors demonstrate core procedures, guide learners through initial attempts while providing detailed performance feedback, then gradually withdraw support as learners acquire confidence and competence. The use of shaping (coaching towards desired performance), chaining, and reinforcement of previously learned material are characteristic of behaviourist approaches to skill development (Driscoll, 2000). The careful sequencing and chaining of procedural learning, along with practice that includes both repetition of previously learned skills and application in new settings, are common in cognitivist learning environments (Driscoll, 2000).

[4] Mastery checklists are used to learn and evaluate skills and procedures. A procedure is broken down into steps, each of which is described as one or more observable behaviours. Evaluation is simple—acceptable performance involves performing each step according to the observable behaviours. Any deviation from the checklist results in the performance being marked as unacceptable.

Behaviourist, and some forms of cognitivist, perspectives are based on objectivist principles and transmission approaches to teaching and learning (Davis & Sumara, 2006; Driscoll, 2000). Knowledge is viewed as an objective, quantifiable commodity to be acquired by the learner (Davis & Sumara, 2006) and learning is defined as change in behavior (Driscoll, 2000). Taxonomies such as Bloom's (as cited in Gronlund, 1995) have described learning as hierarchically demonstrated activity progressing from recall and comprehension to application, synthesis, and evaluation. Similarly, skill development proceeds from anticipation and guided response through increasingly independent performance towards initiation of procedures in novel situations. Evaluation is based on comparing the learner's observable behaviours to predetermined checklists or procedural guides. Context, when addressed at all, is seen as either noise (Streufert, Satish, & Barach, 2001) or as features of a case that require the learner to adapt or modify ideal procedures—such as modifying assessment procedures for pediatric patients (PAC, 2001).

Cognitivist perspectives, based on the concept of mind as analogous to a computer memory, present learning as the development of increasingly rich and complicated mental representations of the real world (Davis & Sumara, 2006). The goal of instruction is to develop mental knowledge structures similar to expert practitioners. Instructional strategies, such as sequencing, chunking, and use of multiple forms of media, focus on how learners attend to and process information, and how they store and retrieve knowledge (Driscoll, 2000). Evaluation uncovers gaps or deficiencies that can then be remediated through additional instruction (Doll, 1993). Cognitive strategies such as template matching, development of mental prototypes, and use of feature analysis (Driscoll, 2000) form the basis of descriptions of the analytic approaches in the medical clinical reasoning process. And the development of illness scripts and

encapsulated knowledge are consistent with cognitivist theories of mental schema in which learners develop increasingly complex mental knowledge structures, integrating their knowledge through hierarchical webs of concepts that are related to each other through key concepts or "anchoring ideas" (Driscoll, 2000, p. 119).

The central metaphors of these perspectives involve construction and mathematics (Davis & Sumara, 2006). Learning is seen as the construction of skill and knowledge building blocks, which are initially derived from analysis of expert behaviour, restated as hierarchically sequenced instructional objectives, then reassembled unproblematically as increasingly complex mental representations which guide the learner's future performance. Learning is a sum of stable skill, knowledge, and attitude-based elements and performance is an evaluation of the learner's observable behaviours against external, objective criteria. The goal of instruction is technical competence: consistent, context-independent performance.

Both cognitivist and behaviourist perspectives promote efficient, effective curriculum approaches that emphasize technical competence. However, as noted in Chapter 1, field practice is a far more subjective exercise—requiring more than mere application of procedures in a noisy, complicated environment. The next section explores concepts that situate learning as more social, more open, and more organic; better able, perhaps, to foster the dynamic approaches characteristic of clinical competence.

Experiential Learning

In this section, I move from the process of clinical judgment to the process of learning in simulation environments. I explore selected experiential learning theories as a rich body of literature through which to explore learning that is "located in everyday workplace tasks and interactions" (Fenwick, 2003, p. 1). Experiential learning approaches highlight the importance of

performance and context as the experiential glue that holds together the disparate elements of the learning environment.

Experiential Learning Perspectives as Different Ways of Knowing

Current literature on experiential learning has its roots in adult education and the recognition that learners must, and do, function in the world (Fenwick, 2003). Adult education strives to "celebrate and legitimate people's experience as significant in their knowledge development . . . [and to acknowledge] the *process* of learning as much as the outcome" (Fenwick, 2003, p. 1). Much of what adults learn, and often where they learn it, is embedded in the everyday tasks of the workplace. Experiential learning, spurred by a desire to better prepare learners for real world practice, emerged as a celebration of learning-by-doing in contrast to traditional academic and classroom-based training. Rather than abstracting performance into chunks of skill, knowledge, and attitude which the learner must acquire, experiential learning perspectives emphasize personal, situated, social, and cultural aspects of learning and performing in the context of practice.

As Fenwick (2003) noted, *experience* itself is a problematic term which can be expressed and used in multiple ways: direct embodied experiences are immediate encounters with the here-and-now; vicarious experiences draw on hearing, seeing, and/or imagining of other's stories and experiences; simulated experiences involve encounters with contrived examples of some real event or situation; and more personal forms include relived or recalled experience, collaborative experiences, or introspection. What is learned from experience is necessarily affected by the purpose for which learners enter an environment, how they perceive and interpret its events, how they filter from their language and existing concepts, what they choose to engage with, and how they conceive of and enact self and society (Fenwick, 2003). Finally, context, and learners'

relationship to and interaction with that context, played a crucial role in this study. Fenwick (2003) noted that it is in the exploration of context "where the dimensions of power and its links to knowledge, language, and identify becomes critical in understanding learning in experience" (2003, p. 19). Here also, she insisted, is where

> we [as adults] must seriously consider our entanglements with our cultural contexts before we assume, unproblematically, that we simply enter an experience, reflect on it to make meaning, then apply its lessons in a process we like to think of as learning. (Fenwick, 2003, p. 19)

Fenwick (2003) identified and explored five perspectives in experiential learning: constructivist, situative, psychoanalytic, critical, and complexivist. Three of these, the constructivist, situative, and complexivist views, were particularly relevant to the background, methods, analysis, and interpretation of this study. The following discussion examines these perspectives' key concepts, views on knowledge, learning, and the role of context in learning.

Constructivist Perspectives

Constructivist perspectives pose learning as an active process of internal knowledge creation involving reflection on concrete experience, abstraction of mental concepts, and development of mental knowledge structures that can be "represented, expressed, and transferred to new situations" (Fenwick, 2003, p. 22). Learners experience the world, perceive or attend to specific facets of that experience, and relate them to existing knowledge and mental concepts. Learning is, in this view, personal, unique, and idiosyncratic. One can only learn or create new knowledge in relationship to what is already known. Thus, new knowledge is a function of both how individual learners engage with an experience (what that learner sees, hears, feels, does) and the existing knowledge structures that the learner has. What each individual learns in any given experience is necessarily unpredictable and unique (Fenwick, 2003).

Heraclitus (as cited in Doll, 1993) claimed that one can never step in the same river twice; while the river itself is a somewhat stable geographic entity, its constituent waters

constantly flow, leading to a myriad of changes in any moment. Similarly, no two learners ever experience the *same* learning activity. They may share participation in an event, but their experiences (what they see, feel, hear, do) and their reflections, abstractions, and conceptualizations are personal and unique. Thus, what individual learners take away from a common learning activity is interpreted through their different perspectives, varied backgrounds, and idiosyncratic sensations and actions, and is shaped by their attitudes, intentions and interests.

Progression of learning involves the development and extension of mental concepts and structures. Piaget (1947/2003) described two processes of assimilation and accommodation. Assimilation involves the process by which new experiences, upon reflection, are related to and incorporated into existing mental knowledge constructs (Fenwick, 2003). However, when the learner encounters sufficiently novel situations or an experience that cannot be easily incorporated into existing knowledge structures, a more dramatic restructuring or accommodation of new knowledge constructs is required (Fenwick, 2003). Thus, the progression of learning involves changes to the depth, breadth, and structure of a learner's mental constructs.

Fenwick (2003) noted constructivist conceptions in Vygotsky (1978), who held that the outcome of learning is the development of individual consciousness through reflection and inner speech. While Piaget (1947/2003) focused on development of individual learners, Vygotsky looked at how the individual was shaped and incorporated into the social collective. Driscoll (2000) noted that Vygotsky highlighted the relationship between learner and context, posing learning as a staged process in which the learner interacts with a community and its activities, tools, and artifacts. Vygotsky described a zone of proximal development, which he defined as a time- and space-bounded site of maximal learning where an individual's existing development serves as a foundation for experiences that are sufficiently challenging to foster learning, but not

overwhelming (Driscoll, 2000). The role of the instructor is to challenge, guide, and coach, encouraging reflection and validating the learner's emerging understandings (Fenwick, 2003).

Constructivist views extend behaviourist and cognitivist perspectives by highlighting the relationship between context, experience, and existing learning. In contrast to constructivist views, mastery learning (Hunter, 1994) assumes that learners construct similar, stable patterns of performance that match objective, external constructs. Instructional design processes assume that learner performance remains stable in different contexts (Winn, 1993, 1996). Constructivist approaches trouble both these sets of assumptions. Learning becomes a personal activity and knowledge becomes a personal construct—focused within the individual, rather than transmission of concrete, objective, external knowledge. Context, in mastery learning, is a source of noise or complication which must be overcome by adaptation. Context, for constructivism, is important as a source of experience and what is learned may change with changing contexts. But, that context is external to the process of reflection and knowledge construction; the process of learning remains focused within the individual (Davis & Sumara, 2006).

However, Fenwick (2003) noted that constructivist approaches pay inadequate attention to the social context of learning and performance. Vygotsky (as cited in Driscoll, 2000) extended narrow constructivists' emphasis on learning as an individual process by examining how learners become part of larger social groups. His work served as a backdrop for situated learning approaches (Brown et al., 1993), which are discussed in the next section.

Situated Learning

Situated learning perspectives recognize that learning is always situated and embedded in "embodied, historically rooted communities of practice" (Hay, 1993, p. 91). "Knowledge is contextually situated and is fundamentally influenced by the activity, context, and culture in

which it is used" (McLellan, 1996a, p. 6). Learning in mastery, cognitivist, and constructivist perspectives involves the transmission, internalization, or creation of knowledge by or within the individual learner (Driscoll, 2000). A situated learning view, however, shifts the focus of knowing and cognition from the individual to sociocultural groups (Driscoll, 2000). Knowledge is not a commodity of consumption or creation; rather, knowledge is part of a process of participation within a specific context and community of practice (Fenwick, 2003).

> Individuals learn as they participate by interacting with a community (with its history, assumptions and cultural values, rules, and patterns of relationship), the tools at hand (including objects, technology, languages, and images), and the moment's activity (its purposes, norms, and practical challenges). (Fenwick, 2003, p. 25)

Brown et al. (1989) challenged the didactic/practical split between *knowing what* and *knowing how*, arguing that the context and social activity of learning are integral and inseparable from what is learned. The instructional design process of task analysis splits experience into skill, knowledge, and attitudinal chunks and bits for acquisition, which, in turn, leads to the development of decontextualized, inert learning (Brown et al., 1989). Learning to use a tool "involves far more than can be accounted for in a set of explicit rules" (Brown et al., 1989, p. 33). The choice, design, and use of a tool reflect and are contingent on the community or culture in which the tool emerges. Similarly, Brown et al. posed that conceptual tools reflect the wisdom, insights, and experiences of a group, and that their meaning emerges from historical and ongoing negotiation within the community.

The progression of learning involves the gradual assumption of increasingly meaningful roles within a community of practice (Fenwick, 2003). A community of practice is "a set of relations among persons, activity, and world, over time and in relation with other tangential and overlapping communities of practice" (Lave & Wenger, 1991, p. 98). The community is more than a group of individuals with common purpose—it is the historical and social source of

interpretive support for meaning-making. Through a process of legitimate peripheral participation, newcomers move from observation and limited interaction at the periphery of a discipline towards full integration and active participation in the community (Fenwick, 2003). Learning is framed, not as acquisition or construction, but as a process of enriched meaning and participation (Lave & Wenger, 1991).

Evaluation in situated learning shifts from defining the deficit of the learner from an external set of objective standards towards the development of identity and acceptance as a member or practitioner in a community (Lave & Wenger, 1991). *Correct answers* or actions are seen as ongoing negotiations of what is relevant or acceptable within a given context (Fenwick, 2003). Assessment, as well as learning is always situated in context, and thus assessment includes both the learner's performance and the overall process of learning (McLellan, 1996b). The emphasis of learning is less on rules and representations than on "modes of acting and problem-solving" (Hanks, as cited in Lave & Wenger, 1991, p. 20). Lave and Wenger (1991) were careful to frame increasing learning as degrees of participation within a community of practice. There is, they claimed, no centre or core towards which learners progress, no closed domain of practice that constitutes complete participation, no linear line of skill acquisition, no end point representing completion of a learning journey. Rather, learners progress in their ability to assume new roles meaningfully within the community (Fenwick, 2003) in a process that extends throughout their careers and lives (Lave & Wenger, 1991).

Lave and Wenger (1991) emphasized that all learning is situated in social, cultural, and historical contexts. They note that the term *situated* refers not just to locating learning in a specific time or place, nor as involving learning with other people, nor even locating within a particular social setting. Their use of the term is far broader. All learning, in their view, is situated

within sociocultural contexts. Learning cannot be dissociated from the contexts in which its participants engage. All learning and knowledge are relational, negotiated, and mutually constituted in the interactions between "agent, activity, and world" (Lave & Wenger, 1991, p. 33). Thus there can be no non-situated learning. Learning of skills and knowledge may be decontextualized, but that decontextualized setting is, itself, a context involving the interactions, assumptions, and norms of its participants, which are necessarily separate from the community and context from which they were extracted.

Situated learning perspectives acknowledge the integral role of context in fostering learning and enacting knowledge. Learning is seen as bidirectional; participation in the community of practice changes both the learner and the community in which she or he is a part. Yet, the central actor in the situated learning perspective remains the individual learner. Davis and Sumara (2006) posed learning as the emergence of new possibilities of response in the dynamic interactions of multiple complex entities.

Ecological and Complexivist Perspectives

Fenwick (2003) noted that ecological and complexivist perspectives pose learning as a process that does more than link learner and context; learning emerges from mutual interaction and change that person and context trigger in each other. Davis and Sumara (2006) described complex phenomena as being comprised of and constituents of multiple other complex entities. Fenwick noted that learners are inextricably bound within a nested set of biological, psychological, and cultural contexts. Davis and Sumara (2006) extended this notion by noting that learners not only act within these contexts, they *are part of* the context. There is no separation between learner and environment. They comingle, coexist, and co-constitute each other. From a complexivist perspective, there is no foreground and background; there are only

systems of mutually interactive agents. Learning does not occur within an individual. Changes (in this context, learning) in the individual change the system the individual is a part of, which in turn triggers further change in the learner. Thus, learning is a process of coemergence: a new pattern of response of learner and context together.

Maturana and Varella (1987) defined structural coupling as a history of recurrent interaction leading to change in the structure of two or more complex entities. Changes in one part of the system lead to changes, or perturbations, throughout its environment. These changes, in turn, trigger responses in other entities that affect the original agent. The result is a new pattern of response, a new structural congruence in the system composed of the two interacting entities, a structural coupling at a higher level of complexity that would not be possible for any of the constituent entities alone.

According to Davis and Sumara's (2006), knowledge refers to the stabilized but changeable patterns of acting of a complex entity. Over time and from different perspectives, what is known is malleable; the stability of knowledge (the range of responses of a complex entity) is variable. What an individual knows "tends to be seen as highly volatile (hence readily affected), whereas a body of knowledge or a body politic is usually seen as highly stable (hence as pregiven and fixed, at least insofar as curriculum development is concerned)" (Davis & Sumara, 2006, p. 29). Thus, change at the level of the individual may take weeks or months, while systemic change at a societal or cultural level may take decades, and change for a species may encompass millennia. Knowledge, from this perspective, is not only an active process, it has a history and a future (Kincheloe & Berry, 2004).

In contrast to objectivist traditions that see personal knowing as separate from objective knowledge, a complexivist view sees knowledge as a series of nested, overlapping

understandings. There is no necessary trajectory to learning, nor does learning necessarily follow a trajectory. Learning is "understood more in terms of ongoing renegotiations of the perceived boundary between personal knowing and collective knowledge" (Davis & Sumara, 2006, p. 27), a process of "continuous invention and exploration, produced through the relations among consciousness, identity, action and interaction, objectives, and structural dynamics of complex systems" (Fenwick, 2003, p. 37). The progression of learning emerges, not as increasingly complicated chains of mental structures, but as increasingly sophisticated and flexible responses to new situations and events (Davis, Sumara, & Luce-Kapler, 2000).

Several aspects of this perspective inform conceptions of simulation as a learning environment. First, a complexivist perspective recognizes—requires, even—that the learning environment involves interaction between a number of dynamic facets: the participants, the script or desired outcome of the scenario, the physical environment, and those who control or manage the simulation. Each agent or actor participates in an ongoing conversation or mutual interaction which, while following a more-or-less known script, unfolds unpredictably as participants react to each other's performance.

A complexivist perspective has the potential to allow a better view of how learning and assessment can occur in situations that involve multiple learners. Other perspectives reviewed in this chapter tend to refer to *a* learner and *the* context. A complexivist perspective removes the distinction between learner and context and recognizes the learning environment as a system including learner(s), context, and multiple participants. Davis and Sumara (2006) reframed cognition as a characteristic of the entity that is seen to be acting. Thus, in a learning environment or activity (such as a simulation), cognition resides in individual participants and their actions, but it also resides in the mutual interactions and responses of all the participants

and the environment in which they are participating. This self-organizing and interdependent activity results in behaviour of the new, larger entity. As such, assessment and evaluation emerges in a "series of increasingly complex systems together [inventing] changing understandings of what constitutes 'adequate conduct'" (Fenwick, 2003, p. 37). Assessments of performance in a complex learning environment become ongoing negotiations between participants in which "claims to truth are understood as means to orient perceptions and frame interpretations" (Davis & Sumara, 2006, p. 33). The focus of evaluation moves away from outputs and behaviours of individual participants to the relationships and mutual interactions between these participants in meeting the goals of the situation.

Experiential Learning Summary

The learning perspectives in this section variously present learning as a commodity for transmission or acquisition; mental representations of concepts that guide thought, choice, and action; the development of increasingly meaningful action within a context; and as emergent and increasingly nuanced and sophisticated responses to new situations and perturbances. Context is presented as noise to be filtered, a source of sensory input, essential background to developing meaning, the medium in which activity gains meaning, and a dynamic element of an open system that is inseparably bound to thought and action.

Each perspective provides insight to selected aspects of the teaching and learning environment. Each highlights different aspects and elements and has a varying horizon. Mastery learning and cognitivism focus on mechanisms of attention and shaping behaviour. Constructivism raises issues of identity and history of the individual in personal meaning-making. Situated learning perspectives see beyond the individual to note social and cultural considerations. And complexivist views embed learners in a web of mutual interaction with other

complex entities and phenomena. These perspectives helped shape the questions, methods, and gathering, analysis, and interpretation of data that formed this study.

The final section of this chapter focuses on simulation-based learning environments and the concept of fidelity. I define and describe the practice learning environment and selected practice learning activities. I present the JIBC's Practice Ladder as a model for matching desired learning outcomes with a variety of practice learning activities. I then develop a working definition of the concept of fidelity and identify the elements of fidelity that are enhanced within this study.

Conceptualizing Simulation-Based Learning

If the patient is the heart of paramedic practice, then performance is its measure. EMS education has focused on performance, initially as the acquisition of skills, later as a function of the integration of assessment and treatment, and more recently as the ability to make and implement clinical decisions that meet the unique needs of the situation at hand. Practice learning activities, simulations, and their derivatives, are the experiential glue that hold together the disparate components of paramedic training, education, experience, and practice.

Experiential, or applied, learning, has as its goal the ability to do real things in the real world, to know and think and make decisions, to function and perform, as do experienced practitioners in a specific domain or discipline. The British Columbia Academic Health Council (n.d.) used the term *practice education* to highlight this applied form of learning as "the experiential learning component of healthcare provider education that occurs in health service delivery and/or simulated settings, and that helps students learn the necessary skills, attitudes and knowledge required to practice effectively in their field" (para. 2). This definition acknowledges then extends traditional conceptions of learning by focusing on process (hands-on experience)

and outcome (effective practice) in the context of performance (in the field). Learning, from this perspective, is far more than memory, mastery, and values; it is a process that immerses and embeds the learners in a constantly evolving web of experience and context.

Practice-based learning activities facilitate interaction between participants and the learning environment with the aim of fostering understanding, developing skills, acquiring values, changing attitudes, gaining experience, or enhancing performance. The term *practice learning activities* was used in this study to describe created experiences, centred on (or requiring) activity, with the goal of fostering the development of competence, proficiency, or expertise within a specific domain or community of practice.

JIBC Practice Ladder

Paramedic programs employ a variety of practice learning activities to help learners master skills, employ procedures, assess and treat patients, and function within their profession. The following analysis frames and describes these activities through the concept of the JIBC Practice Ladder. The JIBC Practice Ladder is an unpublished concept that was used in the development of the JIBC's paramedic programs in the early 2000s. It is a curriculum development device that relates the pedagogical features of desired learning outcomes and common practice learning activities (see Table 2). The JIBC Practice Ladder emerged from an analysis of common practice learning activities used in JIBC paramedic programs. The *NOCP* (PAC, 2001) is based on a task analysis with the goal of identifying the core competencies of paramedic practice; the Practice Ladder is a parallel process that analyzed paramedic practice from a functional perspective.

Table 2. JICB Practice Ladder
Table showing characteristics of common EMS practice learning activities, their characteristics, associated learning goals and instructional focus.

Learning Activity	Characteristics	Goal	Focus
Field Placement or Practicum	Structured work placement with experienced preceptor or mentor. Evaluation is situational, focused on proficiency within field of practice.	Proficiency	Experience (with reflection)
Immersive Simulation	Immersive environment in which participants role play "full call" or incident; post scenario peer and expert debriefing against goals, outcomes, or best practice guidelines	Adaptation	Problem-solving; novel situations;
Procedural Simulation	"Full-call" scenarios with goal of integrating functional processes with procedural skills; structured feedback using rubrics, guidelines, checklists.	Integration	Applications within context of a scenario; decision making
Drill	Short scenario in which one or more procedures are practiced in context; feedback against algorithms, checklists, guidelines.	Sequencing	Complex procedures; multiple procedures within a context
Skill Station	3 Ds: demonstrate, describe, do; participants perform activities under close supervision, evaluation and feedback from mastery checklists.	Mastery	Skills and simple procedural chains; low context/context-independent practice

The central premise of the Practice Ladder is that particular types of learning outcomes are best achieved by the use of specific types of practice learning activities. A given lesson may include a mix of different practice activities, drawing upon skill stations to learn new protocols, simulations to put them into practice, and case studies to discuss subtle elements of differential diagnosis. This instructional structure may be repeated across multiple lessons. The taxonomy is useful for helping curriculum developers match learning outcomes with effective strategies.

The term simulation is an umbrella term that, in practice, represents a wide range of practice learning activities. The Practice Ladder presents a set of these activities, names them, and identifies some of their characteristics. This analysis, however, uncovers the contested meanings that the term *simulation* may represent. The following discussion explores the use of the term and develops a set of definitions used to refer to practice learning activities in this study.

Simulation

The term *simulation*, drawn from the old French *simulacion*, is a noun derived from the verb *simulate*, which is based on the Latin stem of *simulāre*, defined as "the action or practice of simulating, with intent to deceive" ("Simulation," 2013, para. 1, a.). Within the context of medical education, the term to simulate is best expressed as "the technique of imitating the behaviour of some situation or process (whether economic, military, mechanical, etc.) by means of a suitably analogous situation or apparatus, esp. for the purpose of study or personnel training" ("Simulate," 2013, para. 1, d.).

Sauvé, Renaud, and Kaufman (1985, as cited in Kaufman & Sauvé, 2010) identified two general forms of simulations:

- Exploratory or explanatory simulations designed to explore or develop understanding, test theories, or conduct experiments (for example, animations, computer models, business/economic spreadsheets); or
- Performance-based simulations designed to practice and develop competence, proficiency or expertise.

Simulations that foster understanding may be physical or virtual activities designed to model some aspect of the world. Participants observe or participate with the goal of developing mental models or understanding of how some aspect of the world functions. For example, an animation may model the functioning of lung tissue and gaseous exchange. An accounting form may allow users to see how various pricing or inventory strategies play out in practice.

Performance-based simulations create a representation of a physical system in which participants can master, integrate, and adapt skills, knowledge, and judgment through performance, such as setting up a mock Emergency Operations Centre or assessing managing a patient with shortness of breath.

Sauvé et al. (1985, as cited in Kaufman & Sauvé, 2010) viewed simulation environments

as a system and identified the following essential elements:

- A model of representation (a contrived or constructed system);
- Simplification (a simulation selectively focuses on specific elements);
- Dynamism (these elements interact to greater or lesser degrees—e.g., closed systems vs. open systems); and
- Reality defined as a system (there are rules that mimic some aspect of reality; e.g., stop bleeding within 4 minutes or the patient loses consciousness).

Simulations and gaming activities are commonly employed in medicine, aviation, leadership and management, aeronautical engineering, disaster management, and complex military environments (Roscoe, 1991; Streufert et al., 2001). Recorded instances of dramatic performance and reenactments for teaching purposes reach back to Aristotle and mannequins or *phantoms* were used for obstetrical training as early as the 16th century (Barach et al., 2001).

Simulations play a key role in health and medical education (Crookall & Zhou, 2001; Garrett, et al., 2007; Kneebone et al., 2006; Larew, Lessans, Spunt, Foster, & Covington, 2006), bridging theory and practice. Medical simulations purposefully isolate or replicate essential elements of an everyday situation (Streufert et al., 2001) and allow learners to encounter a broad range of patient conditions and injuries. The role of the learner in a simulation is to develop or display a role, function, or duty to the best the learner's ability (Jones, 1997). Simulations are valuable whenever the learning outcome requires dynamism, complexity, hazard, or risk (Streufert et al., 2001), allowing learners to practice, receive feedback, and learn from their mistakes within a controlled and safe environment. Simulations are built around an instructional problem or learning outcome, which may isolate a particular type of patient encounter, focus on assessment and management of conditions, develop specific skills or procedures, or blend all these elements in more open-ended integrative scenarios (Kneebone et al., 2006). Medical simulations allow repeated practice and the development of individual and team skills. The depth, breadth, and richness of the scenario are determined by the requirements of the

educational problem. Simulations are used most effectively when they complement other forms of learning and assessment (Barak, Satish, & Streufert, 2001; Squire & The Games-to-Teach Research Team, 2003). Squire and The Games-to-Teach Research Team (2003) noted that when used within "pedagogical approaches such as case-based learning, goal-based scenarios, anchored instruction, and problem-based learning" (p. 8), simulations and games allow learners to apply content within authentic contexts.

The advent of mannequins and task trainers that realistically simulate complex physiological responses to assessment and treatment has led to research into the validity and acceptance of these technologies (Tsai, Harasym, Nyssen-Jordan, Jennett, & Powell, 2003), the effectiveness of these enhanced simulation environments in developing specific skills (Leblanc et al., 2005; Long, 2005), and their impact on critical thinking (Lasater, 2006; Rhodes & Curran, 2005). Within medical education, there is increasing use of standardized patients to assess clinical reasoning and skills (Adamo, 2003), as well as critical thinking and affective skills (Larew et al., 2006).

Within this study, the term *simulation* was defined both as a verb and a noun. The *act of educational simulation* was the purposeful development of a learning environment that created a system of selected elements and relationships allowing learners, participants, and physical elements to interact and function dynamically with the goal of developing understanding/meaning or changing practice/performance within a desired context. A simulation in this study was a three-phase learning activity, designed around a pedagogical goal, in which participants interacted with other participants, the environment, and an instructor in the context of performing a call or managing an incident. Some or all of the participants and physical elements of the environment may have been represented through simulation. Existing

simulations within paramedic education tend to be closed systems, designed around a known problem with predetermined desired outcomes and expectations. Learners follow a carefully crafted curriculum, first mastering specific skills and procedures in skill stations and drills, then integrating them in the performance of procedural simulations.

The final discussion in this section moves from the structure and use of simulation to conceptions of fidelity. Conceptions of fidelity are a core element of this study. The JIBC Practice Ladder implies that more complex simulation environments are associated with achievement of higher order learning outcomes. This implies that the higher the fidelity of a simulation, the more learners will gain from the experience. However, the findings in this study suggest that it is difficult to speak of *the* fidelity of a simulation and that effective practice learning environments employ a variable range of fidelity of different elements.

Fidelity

The patient is at the heart of paramedic practice, and it is no surprise that fidelity in much of current medical literature focuses on the physiological and procedural realism of mannequins and actors as patients. Yet, fidelity is a far more complex and porous concept than it first appears. Fidelity is not a unitary or even a unifying concept. In fact, patient encounters in simulations and practicum environments involve the interplay of a number of elements, each of which has different degrees of fidelity to calls in the field.

The OED includes several definitions for the term *fidelity*. The best, perhaps, for this discussion is the "degree to which a sound or picture reproduced or transmitted by any device resembles the original" ("Fidelity," 2013, para. 1, c.). Other, older definitions of fidelity imply "honesty, truthfulness, trustworthiness, veracity" ("Fidelity," 2013, para. 2), and involve faithfulness and loyalty.

Within medical education, fidelity has traditionally indicated the degree of realism of a simulation or scenario to field practice (see, for example, Gaba, 2004). But fidelity extends beyond the presentation of the patient. While much of the medical literature on simulation has focused on the ability of human patient simulators (computerized mannequins) to present complex physiological and procedural accuracy (McFetrich, 2006), other authors have situated fidelity as a broader construct, such as Garrett, et al.'s (2007) definition of fidelity as "the degree to which a simulation provides an accurate and truthful representation of the original phenomenon" (p. 10).

Beaubien and Baker (2004) cautioned that unidimensional definitions of fidelity conflate the affordances of instructional technologies with the overall effectiveness of simulations, implying that the use of higher fidelity mannequins leads to improved learning outcomes. They noted that a variety of models of fidelity have been proposed. Norman et al. (2012) reviewed studies on medical simulation that called upon work from simulation in aviation to distinguish between "'engineering fidelity', which refers to whether the simulation looks realistic, and 'psychological fidelity', which concerns whether the simulator contains accurate simulations of the critical elements that will demand specific behaviours to complete the task" (p. 645). Beaubien and Baker outlined Rehmann et al.'s typology of equipment, environmental, and psychological fidelity as a model that more robustly considers the multidimensional aspects of fidelity. Similarly, Gaba (2004) noted 11 factors for consideration in the development of simulations.

Typical procedural simulations in the classroom environment focus on the patient and the physiological condition being studied. By contrast, learners in the practicum environment are assessed against a set of criteria based on the *NOCP*'s (PAC, 2011) seven competency areas.

Areas 4 and 5 deal with typical aspects of patient care: assessment and treatment. These are the aspects of fidelity highlighted in existing simulations that promote technical competence. Area 2, however, includes competencies that require the paramedic to interact effectively with the patient, family members, and other health care providers and emergency responders. Areas 1 and 7 include competencies involving dealing with environmental factors, such as gaining access to the patient, packaging, and transporting. Area 6, integration, requires practitioners to function within the principles, protocols, and operational guidelines of their workplace. Together, these competencies extend far past the presentation of the patient or the ability of the practitioner to perform invasive procedures in a realistic manner. Simulations designed to meet these broader competencies must also create opportunities to engage with the physical environment; deal with patients with rich personal, health, and social histories; interact with bystanders and other responders; function within expected curricular or operational guidelines; and consider social and cultural factors.

Viewing fidelity as a complex phenomenon expresses the multidimensional conception of fidelity as a set of nested relationships that form a simulation experience. Thus, the aspects of the environment that experienced practitioners would interact with and consider in their decision making form the basis for choosing which aspects of fidelity are relevant in designing a simulation.

The following section explores the concept of fidelity as a complex construct of nested interrelationships, which in this study are organized into categories involving the patient, the context, the curriculum, the community of practice, and broader social/cultural factors (see Figure 4).

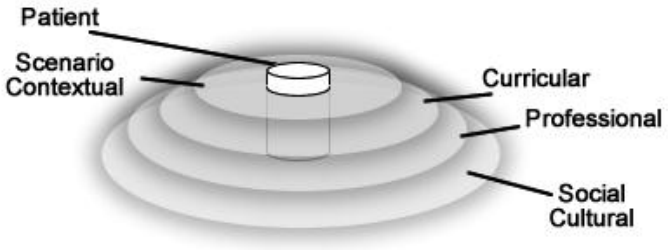

Figure 4. Layers of fidelity considered in this study.

Patient fidelity. Fidelity in medical simulation often focuses on three aspects of patient fidelity: physiological, procedural, and interpersonal. *Physiological fidelity* refers to the accuracy with which patients exhibit physical symptoms and display vital signs indicative of particular injuries or conditions and the ability to change that presentation in response to participant activities (e.g., administering medications). *Procedural fidelity* is an indication of how closely an activity in a simulation resembles its performance in everyday practice. The *interpersonal fidelity* of a situation refers to the interactions between participants, including channels of communication such as verbal, physical, facial expression, body language, etc.

Thus, task trainers such as an IV arm allow high procedural fidelity (the user can see and feel when the catheter pops into the vein), but limited physiological fidelity (the mannequin does not flinch or respond to the procedure) and no interpersonal fidelity (the interactions with the patient are usually not part of practicing with the IV arm or, if the arm is used in a scenario, the patient response is verbalized by the call manager or actor playing the patient). By contrast, HF mannequins may allow a wide range of realistic procedures (such as taking vital signs, monitoring ECGs, administering medications) and display accurate and dynamic vital signs (either preprogrammed by computer or manually by a call manager). However, the mannequins have poor interpersonal fidelity (no facial movement or body language; note that some

mannequins have speakers allowing an instructor to provide the voice for the patient). Actors have high interpersonal fidelity, but their procedural and physiological fidelity is variable. Physical findings (such as pallor,[5] bruising, or even fractures) may be simulated by moulage (theatrical makeup) and prosthetics. However, a call manager may have to verbally provide abnormal vital sign readings and physical findings. And of course, invasive procedures cannot be performed on actors.

Context fidelity. A second set of relationships focuses on the scenario itself, its physical setting, and the presence and role of different participants. *Environmental fidelity* refers to the physical context or setting of the scenario. *Participant fidelity* indicates the degree to which various participants who would be present in a field setting are included in the scenario. *Role fidelity* refers to the degree to which the roles of participants in field practice are modified or constrained in a simulation.

Skill laboratories often include multiple stations with a variety of task trainers that allow learners to practice performing specific skills and procedures with minimal context and low environmental, participant, and role fidelity. Immersive simulations provide high participant fidelity through the use of actors portraying the parts of patients, bystanders, additional rescuers, and hospital personnel. Many medical and health simulation laboratories recreate mock hospital wards or operating theatres. Environmental fidelity for prehospital education is increased by staging scenarios in realistic settings or purpose-built rooms that simulate residential or commercial spaces. In simple drills or simulations, role fidelity is constrained by asking participants to verbalize actions or think aloud so that instructors can assess their decision making processes. Role fidelity is increased by allowing participants to function as they would in everyday practice. When role fidelity is high, participants remain in their roles through the entire

[5] Pallor: pale, cool, sweaty skin, which may indicate that the patient needs immediate treatment.

scenario and have little direct interaction with the instructor or evaluator.

Curricular fidelity. *Curricular fidelity* refers to the degree that a simulation meets its pedagogical intent. Simulations are learning activities staged at specific location in a curriculum, each with a specific set of learning goals, such as skill acquisition (e.g., integrate airway management procedures with the Primary Survey), integration (e.g., demonstrate the assessment and management of chest pain patients using PCP protocols and procedures), or adaptation (e.g., manage a patient with musculoskeletal injuries in a practicum placement). Two elements are particularly relevant: the structure of the case and the richness of its presentation.

Cases can be structured as exemplars or more ambiguous presentations of an injury or condition. In addition, the intended flow and outcome of a case can be straightforward or complex. Simple calls present classic presentations with predictable outcomes to the intended treatment. More complex calls may include multiple conditions, atypical presentations, or complicated responses in which the desired treatment initiates a new treatment problem.

Another element of curricular fidelity is the richness or complexity of information in the case. A case with higher fidelity in terms of richness would present a robust, comprehensive patient history and a well-developed story. A rich case contains data that are not necessarily relevant to the presenting problem of the case, but provide an aura of authenticity due to their comprehensiveness. Case studies or drills with lower fidelity may have very abbreviated data that focus primarily on the particular issue or condition that the case is addressing.

Professional fidelity. *Professional fidelity* is the degree to which a simulation represents or requires the learner to practice within a particular context or community of practice. The context of practice refers to the operational setting of a simulation. All paramedics follow general principles of management for assessing and managing a variety of injuries and

pathophysiological conditions. However, the specific practices they follow vary according to the context in which they practice. These differences can include location, operational role, types of calls that are typically encountered, types of equipment that are available, and protocols and procedures specific to the operational setting or agency.[6] The general principles of managing a patient with a closed head injury and bleeding in the skull are common across fields. But calls involving that same injury may unfold very differently in different contexts.[7]

Social and cultural fidelity. The fidelity of a simulation is also set within broader social and cultural spheres. The fidelity of a simulation must also consider the diversity and distribution of different call types, patient backgrounds, and cultural norms.

Social fidelity considers the degree to which the simulations in a program reflect relevant societal and social factors. A particular curriculum may be designed to cover a broad range of injuries and conditions, set within the operational context of one or more professional settings. But actual practice can vary through a number of social and cultural domains. The range and characteristics of actual calls vary with the local social and economic factors, along with the demographics of its inhabitants and their ethnic and cultural practices. Thus, practice in communities in the north of Canada that area focused on the oil industry will tend to involve a younger population, with a focus on industrial injury, drug and alcohol use, and, potentially, interpersonal violence more so than a rural community with a large population of retirees.

The social and *cultural fidelity* of a scenario extend to interactions between the participants in the scenario. Expectations and relationships are quite different for various cultural

[6] For example, paramedics may function in diverse settings such as search and rescue, industrial or occupational first aid, ski patrol, lifeguard, first response, primary care paramedic, advanced care paramedic, and community care.
[7] A pedestrian struck by a vehicle and a pilot from a crashed ultralight may both have a closed head injury. Yet, the priorities, actions, and specific protocols used by a paramedic responding to a pedestrian struck call in downtown Vancouver are very different than those of a search and rescue technician who parachutes into the scene of a crashed ultralight plane at dusk.

groups. For example, when working with paramedics who will practice in Singapore, a call involving a Muslim woman who collapses in her home with a vaginal bleed or impending birth presents different challenges to an all-male paramedic crew and a crew with a female member.

Simulation-Based Learning Summary: Simulation and Fidelity as Complex Constructs

Fidelity in a simulation is far more than a function of the technology and setting in which a patient encounter is staged. Despite its potential and recent growth, many health education researchers caution that the simulation environment is poorly understood and its theoretical foundations are as yet underdeveloped (see Bradley & Postlethwaite, 2003; Garrett, et al., 2007; Kneebone et al., 2006). These voices have echoed similar calls in broader educational technology literature. In their time, radio, educational television, and film were all hailed as prompters of radical change in education (Bates, 2000). The slow initial incorporation of multimedia and computer-based learning spurred a spirited set of discussions on the role of media and technology in learning.[8] These discussions highlighted the importance of placing any educational technology in the context of its use. While different technologies have different affordances (Franklin, 1999), their use is neither neutral nor benign (Postman, 1992). Proponents of new technologies look for problems to which they can apply their practice. Educational technologists caution to ask first what one wants to do, then choose the technologies that best meet one's needs (Bates, 2000; Heinich, Molenda, Russell, & Smaldino, 1999).

My research explored how HF simulation might help to bridge the gap between technical competence and professional practice. A key element of this research asked, what are the affordances of simulation and how can simulation environments help meet differing learning

[8] Clark (1984, 1993) posed that media merely delivered a particular learning activity and that learning was a function of the instructional interactions themselves, not the media in which they were developed. Kozma (1991) challenged this assertion, seeing learning as a constructive activity involving interaction between the learner and the content, which includes its delivery media or technology.

goals in EMS? In this sense, the fidelity of any learning experience, such as a simulation, is better conceived of as its fit with its pedagogical intent or purpose. In other words, different learning goals may require different blends of fidelity, focusing on different aspects of the environment. This expression views technology through the lens of learning, rather than subordinating learning to the affordances of a particular technology.

Viewing simulation and fidelity as complex phenomena allows educators to acknowledge the open-endedness of participation in these practice learning activities. A simulation environment that fosters interaction between learners and a broad range of contextual elements requires a rich milieu in which participants and elements are allowed to play their parts outwards from a starting set of conditions, rather than being constrained within the limits of the script. Complex phenomena exist in co-dependent interaction (Davis & Sumara, 2006) from which learning emerges as new patterns of practice within an expanding sphere of possible actions.

In this sense, the fidelity of any learning experience, such as a simulation, is conceived in this study as its fit with its pedagogical intent or purpose. The conceptions of developing clinical judgment as increasing awareness of context, simulation as the creation of conditions from which elements and participants can dynamically engage, and fidelity as a set of dynamic, overlapping, nested relationships between selected elements in a learning environment and the field setting it is representing, serve as organizing concepts in the creation of the simulations in this study, gathering and analysis of data, and interpretations of its findings.

Problematic Terms

Several problematic terms are used throughout this thesis. The study explores two overlapping but fundamentally different ways of conceiving expertise and learning. Terms such as *truth*, *reality*, *experience*, *authentic*, and *mastery* are associated with positivist views of

knowledge that underlie assumptions of technical rationality and inform a cognitivist learning theory upon which much of current Canadian paramedic education is based. The sense of objectivity and universality implied by these terms are problematic from the interpretivist, multivocal perspectives that informed this study. However, it is difficult to describe the current program, or its conceptual understandings and practices, without using these terms. I use these terms in this document when speaking or describing facets of the study and its findings with a cognitivist voice. Further, I employ these terms with hesitation and with an awareness of their troublesome conceptual foundations.

Two terms, in particular, are deeply embedded in the language of simulation and paramedic education respectively. The following definitions are offered for *authentic* and *mastery* as used in this study.

Simulation literature often uses the term authentic to describe practices and conditions found in everyday practice. Simulation environments deliberately re-create situations which, to greater or lesser degrees, contrive or control facets of a situation. For example, current classroom-based simulations constrain the role of the paramedic driver in order to focus educational assessment and evaluation on the attendant. Thus, the driver in a simulation is restricted from providing correction or advice to the attendant. In field practice, a more authentic role allows the partner to critique, offer advice, provide correction, and act collaboratively. In this sense, I use the term authentic in this study to describe the everyday aspects of some function or activity as generally understood by practitioners in that context. For example, an authentic location refers to the type of physical location and environment in which a paramedic practitioner would expect to perform a particular type of call. An authentic location for a patient experiencing a heart attack could include a middle-aged male in an office setting or in the home.

Mastery learning methods as articulated by, for example, Hunter (1994), are deeply embedded in the language and practice of paramedic education, particularly in the development of core skills and procedures. I use the term mastery, and the verb to master, in this study in the sense of learning a skill or procedure through guided practice, repetition, and internalization. Mastery, from a cognitivist perspective, is demonstrated through achievement of technical competence: consistent, independent (uncoached), timely, accurate, and appropriate performance of a procedure compared to a clearly articulated set of observable behaviours.

Chapter Summary

I have presented, in this chapter, literature from which to develop and support the core concepts and perspectives that informed my decisions, methods, analysis, and interpretation in this research. Postmodern theorists inspired my choice of a multiple perspective approach and an iterative, inductive exploration of the development of clinical judgment in dynamic, immersive simulation environments. I developed my definition of clinical judgment as a form of expertise involving discernment of contextual factors from a complexivist reading of literature from EMS, health and medical education, clinical reasoning, and naturalistic decision making. I drew upon models of skill acquisition and professional expertise, along with concepts from experiential learning literature, to pose learning in simulation as a complex phenomenon involving the development of increasingly nuanced responses to dynamic environments. Finally, in this chapter, I posed a working definition of fidelity as a set of complex and dynamic relationships between desired learning outcomes and selected elements of the learning environment.

Having set the background and theoretical perspectives for this study, I turn next to describing the study itself. In the next chapter, I present my research approach and methods and outline the unfolding of the data collection, analysis, and interpretation.

CHAPTER 3: METHODS

The questions in this study explored the relationships and interactions of participants and selected elements or agents in the simulation environment. I set my research as a mixed-method multiple-case study (Yin, 1994a). I called upon Kincheloe's and Berry's (2004) concept of multivocal research to examine the concept of clinical judgment through a series of conceptual layers. The initial relationships that I chose to look at in this research included a phenomenological exploration of who and with what the participants interact in a simulation environment; how participants make decisions; how they structure and report their experiences; a critical analysis of what forms of authority they base their judgments on; and to what extent they consider personal, social, and cultural factors in making patient care decisions. I gathered data from two sets of scheduled classroom simulations in the PCP program and from a new HF simulation module developed for this study. I used observation and video recordings of simulations within the natural setting of the curriculum and focus group interviews to collect data that explored how the various agents and participants in the simulations acted and interacted, what sources of authority they called upon, what forms and substance their reports and discussions took, and what artefacts they created. I developed descriptive statistics from questionnaires and quantitative examination of specific activities and functions observed in the video recordings and interviews.

Analysis and interpretation was a purposeful synthesis of method aimed at emergent theory and understanding of the phenomena at hand (Kincheloe & Berry, 2004). Following a postmodern approach, I engaged in deliberate exploration of selected aspects of data with the pragmatic goal of developing and refining insight into the concepts of complex simulation-based learning environments, as well as the relationships between participants and elements of these

environments (Creswell, 2012). I employed an inductive and iterative approach to analysis, remaining open to the emergence of understandings in an interpretivist reconstruction and reconceptualization of my core concepts. Thematic analysis included use of both emergent and theoretical coding (Creswell, 2012; Merriam, 1988). Dreyfus and Dreyfus' (1986) and Dreyfus' (2001) model of skill acquisition served as a backdrop for looking at the progression of learning and differentiating between performance in classroom and HF simulations. Schön's (1983) phenomenological work on the development of expertise informed exploration of how the participants interacted to foster learning in HF simulation settings. I used phenomenological description and critical analysis in posing the development of professional practice as an intersection of knowledge, performance, and authority. Riessman's (1993) framework for narrative analysis provided an approach for uncovering evidence of clinical reasoning in the reports and documentation of the participants.

Design

The primary data for this study came from two days of HF simulations conducted in New Westminster and Kelowna, British Columbia, along with simulations conducted as part of ongoing PCP cohorts in New Westminster, British Columbia. I also gathered data from semistructured focus group sessions conducted at the end of each simulation day and an unstructured interview with a group of participants six months after the HF simulations.

The study was designed as a multiple-case study (Yin, 1994a) exploring individual simulations as objects of study that are embedded in, and in which are embedded, other possible objects of study. The primary case in this study consisted of an individual simulation, which included the setup, the scenario itself (including all the participants and their interactions), the debriefing session following the call, and all documentation related to the call (see Figure 5).

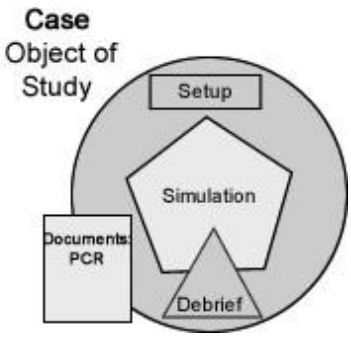

Figure 5. Simulations as individual cases.

I examined a number of cases or simulations and the interactions of the participants in those cases. While temporally bounded as an object of study (Merriam, 1988; Yin, 1994b), each case was also set within a pedagogical context as part of a series of planned learning activities, taking the learners on a journey from the textbook to the street. The pedagogic goal of any particular simulation was also set within a larger construct of cases designed to develop a set of prototypical experiences and mental representations which, in turn, became part of the corpus of experiences upon which the learners will draw in their future practice (Norman, 2005). Each simulation occurred at a specific point in time, but its experience was set within a series of simulations that occurred during a simulation day, which itself included set-up and debrief discussions. Each day formed part of a larger map that was nested within the courses, programs, and eventual experiences that will form the participants' careers. In addition, the goal of the HF simulations in the new curriculum module was to bridge out from the confines and evaluative expectations of a closed curriculum and place the learners in situations in which they could/should act within broader professional, social, and cultural considerations. Each participant entered the simulation with his or her own unique histories, perspectives, learning goals, and intents (Mylopoulos & Regher, 2007). Each brought his or her past performance, previous experiences, and personal learning profiles into the moment.

My primary object of study was the processes by which participants engaged and interacted with each other and with selected elements of the simulation environment to foster learning. My analysis explored how participants functioned in HF simulation, how they engaged with the environment, how they made decisions, and what they perceived to be real or true in simulation. My interpretation investigated the progression of learning, fidelity, discernment, different ways of knowing, and fostering the development of clinical judgment.

I followed an iterative and emergent process in the analysis and interpretation of the data. I employed a systematic approach to qualitative research (Creswell, 2012; Huberman & Miles, 1983; Merriam, 2008). Following Kincheloe and Berry (2004), I purposefully employed several analytic methods, drawing on a number of theoretical models and concepts to answer specific subquestions as the process unfolded. This process consisted of a series or rounds or phases of analysis and interpretation:

- Descriptive analysis;
- Refinement of subquestions and selection of analytic strategies and tools;
- Coding and analysis (theoretical and emergent);
- Identification and exploration of patterns and themes;
- Development of conceptual categories related to the research question and goal; and
- Interpretation and discussion.

This list presents the steps of analysis and interpretation in a much more linear manner than that in which the activities occurred. Creswell (2012) noted that qualitative analysis is iterative and cyclical in several dimensions. He referred to the “data analysis spiral” (Creswell, 2012, p. 183) as a process of interrelated, often simultaneous or overlapping activities that involve organizing, reading, describing, classifying, and interpreting data in a successive consolidation and narrowing of data towards findings and theory. While there is an overall flow to the process, the phases blend into each other and the researcher may return to previous phases

as emergent questions or meanings emerge. For example, the gathering and articulation of descriptive data and the coding process in this study are described as initial stages of the process. Yet, I continually returned to and refined these activities as I progressed through the overall process of analysis and interpretation. Many of the emergent codes and data tables developed through articulation of subquestions; the emergence of other codes spurred the articulation or abandonment of different subquestions. Thus descriptive, coding, and analytic activities are better conceived of as activities that were initiated early in the process, but continually embedded within broader and ongoing analytic and interpretive methods.

Development of Simulations in the Study

The following sections describe selected characteristics of several types of simulations encountered in this study. The Core Skills and Classic Case simulations are part of the PCP curriculum, while the HF simulations were created for this study.

Location of simulations in the curriculum. The PCP program is designed on a building block metaphor. The program consists of nine courses delivered over 20 weeks, followed by a three-month practicum. Program content is structured from simple to complex and generic to specific. Students initially learn the core skills and procedures of paramedic practice, then integrate these into the recognition and treatment of classic presentations of common injuries and medical conditions. Next, they adapt their approach to deal with cases complicated by special situations (e.g., vehicle extrication) or special populations (treating pediatric patients). Finally, the students move to clinical practice in hospital and field placements. The simulations in this study were drawn from three points in this process: the end of the Core Skills component, during the Classic Case phase, and at the end of the classroom courses but before learners moved to the field practicum (see Figure 6).

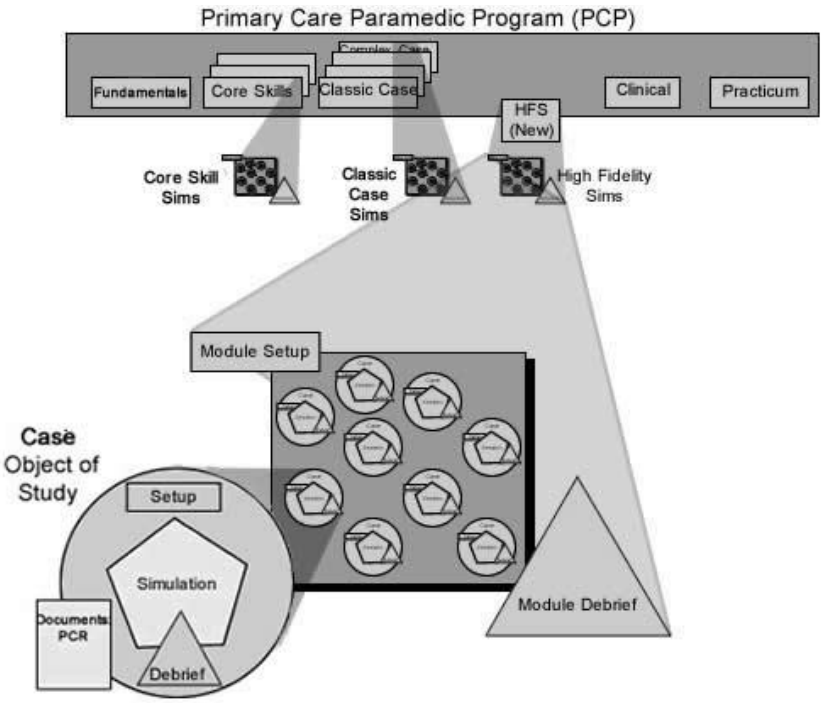

Figure 6. Location of simulations within curriculum.

Characteristics of simulations in the study. All three forms of simulation shared characteristics. Each created a space where paramedic students encountered a contrived environment, interacted with a mock patient, performed tasks in a more-or-less realistic manner, made decisions, and then discussed or reflected on their performance. However, various types of simulation created very different learning environments.

The intent of the Core Skills simulations was to practice core ambulance procedures in the context of a simple call. The Core Skills simulations in this study covered basic wound management, fracture management, and cardiac arrest. By contrast, Classic Case 253 was a summative course in which students performed a set of procedural simulations. Classic Case simulations were more complex than Core Skills calls. The learners integrated their knowledge of pathophysiology and their skills in assessment and treatment to manage common illnesses and injuries. Classic Case simulations focused on integration and clinical decision making.

Design of HF simulations. I developed a one-day HFS module, creating an immersive environment that increased the fidelity of selected elements related to my conception of clinical judgment. HF simulations that foster the development of clinical judgment should more closely represent the noise, complexity, and unpredictability of field practice. This section describes my decisions related to developing the HFS environment.

The fidelity of a simulation may be considered the intersection of a set of factors that match different blends of realism to the educational and curricular requirements of each call. I considered the following elements in designing the HF simulations.

Setting. Both the Core Skills and Classic Case simulations were designed to simulate an operational field setting in which two students play the roles of attendant and driver. The call manager and/or instructor are not active participants in the call, intervening only when necessary to provide verbal information not available in the simulation itself.

I chose to set the HF simulations in the practicum environment, where the two students would function alongside a practicing paramedic in the role of preceptor. In this environment, the preceptor explicitly functions as a mentor and helps bridge the student from the classroom to the field practice. Students could function in operational roles set within an environment that more closely represented the field setting, while still situated within an educational context. The activities of coaching, providing feedback, questioning, explanation, and evaluation are all expected and a normal part of a practicum experience. Thus, I could observe the students performing within a simulated practice setting and explore their thoughts, rationale, and experiences within an environment that seemed—to the participants—familiar.

Role fidelity. I sought to have the participants in the HFS environment function in a more natural manner by allowing the attendant, driver, and preceptor to perform as a team. The focus

of most classroom simulations is on the one student who is being evaluated; in EMS terminology, he or she is “in charge” of the call. In the field, crews function both more independently and more collaboratively. The attendant is in charge of the call; however, in practice, all members of the crew (which, in a practicum includes the preceptor as well as the student in the role of the attendant) contribute to decision making and completing the various tasks. I explicitly asked the participants within the HF simulations to take on roles that more closely resembled field practice.

Interpersonal fidelity. Calls in the field are often situated in public spaces with bystanders or in homes with family members. In addition, paramedics often function in a complex milieu involving first responders (fire fighters, life guards, search and rescue personnel), police, nurses, physicians, and dispatchers. In classroom simulations the activities of these people are usually provided by the instructor/call manager as verbal information. I chose to increase the fidelity of these interactions by richly populating the HFS calls with secondary participants playing a wide range of roles.

Social/cultural fidelity. My intent was to create a rich, social HFS environment in which the participants would have opportunities to interact and function. The inclusion of multiple people in the simulations also provided opportunity to increase the social and cultural fidelity of the simulations. I chose to situate the calls, and the people in them, in a range of situations that included chronically or terminally ill patients who could no longer cope in their homes, patients with minor injuries set within domestic abuse contexts, homeless patients, patients involved in interpersonal conflicts after a minor motor vehicle accident, and patients in very public spaces. I also chose to develop and run the scenarios as ongoing incidents. Several scenarios were staged as police or life guarding incidents that ran for several minutes before the arrival of the

paramedic crew. Thus, the paramedic participants became part of an ongoing situation, but they were not the central participants.

Environmental fidelity. Core Skills calls performed in classrooms had very low environmental fidelity, while the Classic Case calls were staged in both classrooms and alternate locations across the campus. In classroom simulations, the environmental information is provided by the call manager. Note, however, that some environmental information (e.g., location in the community that the scene represents, time of year, time of day, etc.) was provided verbally, even when scenarios were staged around the campus. In general, the students worked with actual equipment, used in a realistic manner (with the exception of performing invasive procedures such as starting intravenous lines or administrating medications). Whenever possible task trainers (such as IV arms) or mannequins were used to increase the procedural fidelity of the simulations.

I staged the HFS calls in environments appropriate to the call type (e.g., a pedestrian struck scenario in a parking lot) and included props and peripheral equipment. I also set up a staging area for the ambulance crews and a hospital triage station. I had initially planned to have ambulances so that the crews were able to load and drive to the hospital. Unfortunately, the HF module was staged shortly after the start of job action between the local ambulance service and its union. I was unable to use ambulances for either HFS day. Instead, we set up mock ambulances in the gymnasium. The crews loaded their patient on scene, moved to the mock ambulance to simulate transport, then unloaded and took their patients to the triage station.

Patient presentation. Classroom simulations are designed to provide prototypical examples of common injuries and conditions. In general, the calls are designed to reduce noise or distractions in the form of atypical presentations or extraneous environmental factors. In practice,

however, patients present with a wide range of signs and symptoms, with considerable variation in the acuity of their condition, and an entire life and health history that compounds and confounds their presentation. In constructing the simulations for the HF days, I chose to have four levels of patient acuity, ranging from calls in which no transport was required (either the patient had no illness or injury or the presentation did not warrant further medical attention) to several cases of traumatic and/or cardiac arrest. While classroom simulations focused on serious conditions requiring complex treatment, I weighted the calls in the HF days towards fewer critical calls, reflecting more closely a typical day in the field. In addition, the presentation of the calls was complicated by a variety of environmental, social, and cultural factors.

Physiological and procedural fidelity. In this study, I placed an increased emphasis on role and interpersonal, environmental, and social/cultural fidelity. This led to some tension with regards to the physiological and procedural fidelity of the simulations. While HF mannequins provide high procedural and physiological fidelity, they are less effective for situations requiring interpersonal interaction or movement. However, using actors limits the ability of participants to perform invasive procedures or administer medications. And, if the vital signs in the scenario script are outside the actor's normal range, then this information must be provided verbally.

I chose to use a mix of mannequins and actors for the HF scenarios. The majority of calls in the HF days did not require invasive procedures. My definition of clinical judgment emphasizes interaction between participants and the importance of increased role, social, and interpersonal fidelity over procedural fidelity. Thus, I felt that actors should be used whenever possible. I limited mannequin use to those calls in which the patient had a decreased level of consciousness, the vital signs were abnormal, and/or the call required advanced or invasive procedures (intubation, IV access, defibrillation). On one call, an actor role played a patient with

chest pain who collapsed in cardiac arrest partway through the scenario. At that point, we replaced the actor with a mannequin.

Call type: Injury/condition. I analyzed the types of simulations in the curriculum and the types of calls that practitioners encounter in practice. Simulations in the curriculum are specified by the *NOCP* (PAC, 2001) and structured to sample the skills and procedures that define a paramedic's scope of practice. However, ambulance calls are usually dispatched on the basis of the patient's presenting symptoms (chest pain, unconscious collapse) or mechanism of injury (motor vehicle incident, fall from a height). Distinguishing between call type and the patient's underlying medical condition is the basis of clinical reasoning. Thus, I chose to base the selection of scenarios for the HF simulations around call types rather than specific injuries or conditions.

Selection and creation of the HF simulations. I envisioned the HF simulation module as "a day at work"—an experience of a typical shift for a paramedic in an urban setting. British Columbia Ambulance Service (2003) statistics indicated that a typical shift consisted of eight to 10 ambulance calls, of which three would not involve transport (for example, calls with no patient found, no injuries, or a patient not requiring further medical care). Of the remaining calls, only one or two would be serious enough to warrant the use of protocols or advanced procedures. Typically one in five involved trauma; another one in nine involved chest pain. The remaining calls were distributed across the scope of practice.

I chose a series of basic call scenarios that would allow for significant variability in outcome. Ideally, the calls should allow students to encounter a diverse set of experiences that included innocuous to critical medical conditions; interesting environmental considerations; interactions with a wide variety of other responders, bystanders, and family members; and complications from interpersonal and social/cultural factors. I chose a series of motor vehicle

and/or pedestrian/vehicle incidents, man [*sic*] down calls (collapse on the street), several incidents at a local swimming pool, domestic disputes, falls, chest pain, shortness of breath, and several sick NYD (not yet diagnosed) calls.

I created a matrix of call types and categories of acuity. I met with a group of instructors to brainstorm realistic possibilities for each cell in the matrix. We added additional scenario factors so that the calls would be interesting and challenging, but not overly contrived or unrealistic. The matrix listed 35 possible calls, allowing different blends of calls for each of the three crews in the Vancouver cohort. I gained access to sites across the JIBC's New Westminster campus in which to simulate park settings, a cafeteria, office space, an intersection, a parking lot, an industrial site, meeting rooms, an apartment (purpose-built simulation room with kitchen, living room, bedroom, and washroom), gymnasium, and public spaces. We also arranged to do several calls with lifeguards in the community swimming pool adjacent to the JIBC.

In Kelowna, I had access to fewer personnel and more limited locations. We chose to create four basic calls that employed the same set of actors. The crews rotated through the calls. However, we encouraged the participants to vary elements of the scenario between iterations—the intent was to create dynamic situations and have personnel respond to the actions and interactions of the other participants, not try to recreate the same call across different groups of students. The Kelowna calls included a patient with (noncardiac) chest pain walking in a residential neighbourhood, a domestic dispute in a trailer configured as an apartment, a pedestrian/vehicle accident in a parking lot, and a collapse on the street. The final call of the day was a multiple shooting call in which all crews participated.

Ethical Considerations

I followed the principles of the *Tri-Council Policy Statement: Ethical Conduct for*

Research Involving Humans (Canadian Institutes of Health Research, Natural Sciences and Engineering Research Council of Canada, & Social Sciences and Humanities Research Council of Canada, 2010) and met all requirements of both the University of British Columbia Behavioural Research Ethics Board and the JIBC Ethics Review Committee. I used a variety of methods to ensure that participants provided voluntary and informed consent to participation in the study. I informed the participants, both in person and in writing, that their participation was voluntary and that they could remove themselves and their contributions to the study at any time. I outlined the background, purpose, procedures, and ethical implications of the study in person when initially meeting the classes, by providing an information sheet, and through the informed consent form (see Appendix A). I described the data collection methods and outlined the procedures that would be followed to protect their identity and maintain confidentiality. The study involved both group participation, focus group interviews, and use of audio and video recordings. Thus it would not be possible to ensure that participants could not be identified, either in the transcripts and narrative descriptions of simulations or in the use of media in activities that emerged from the study. In addition to the informed consent form, all participants signed a media release allowing their images, audio, and video recordings to be used in publications and presentations (see Appendix A).

I followed several procedures to maintain participant confidentiality in this dissertation. I replaced participant names in the transcripts and narratives, identifying participants with pseudonyms or by their roles in the activity (for example, students in the roles of attendant and driver/partner are referred to as PCP1 and PCP2 or as the attendant and the driver; preceptors are referred to as the Preceptor). In some instances, I created pseudonyms for particular participants when it was necessary to use names. All data from the study will be maintained in a locked filing

cabinet or in password protected hard drives in my locked office for a period of five years, after which time the data will be destroyed.

Sample

I collected data from 75 simulations. I recorded simulations from two courses in the ongoing PCP program: Core Skills 220 (CS220) and Classic Case 253 (CC253). In addition, I created a series of HF simulations that were conducted during one-day sessions in New Westminster and Kelowna. While the simulations in the HF simulation module were created specifically for this study, I had no choice on what simulations were used on the Core Skills and Classic Case simulation days. The Core Skills and Classic Case simulation days were the scheduled simulations at the time of the study. Thus, the initial population of simulations I could draw from included both purposive (Palys & Atchison, 2008) and haphazard or convenience cases (Merriam, 1988). I subsequently employed several theoretical (Palys & Atchison, 2008) and purposive sampling strategies to focus analysis on selected cases that best provided useful data for specific subquestions in the study (Merriam, 1988).

Study Participants

There were two groups of personnel in this study: study participants and simulation participants. The distinction between these groups was sometimes difficult to maintain. The study examined the interaction of the study participants with features and other participants in the simulations. For the purposes of the following discussion, the study participants include the students acting as paramedic crew during simulations along with the instructors and preceptors who provided instruction, assessment, and guidance during the simulations.

Recruitment of study participants. Creswell (2003) advocated the purposeful selection of sites and individuals in order to best develop understanding of the research question and

subquestions. I did not seek cross-case comparison of specific preselected variables, nor was I focused on validating or exploring the representativeness of my initial categories. Thus, I did not employ quota, identical case (Palys & Atchison, 2008), maximum variation, or homogeneity strategies (Creswell, 2012). I did, however, employ a purposive strategy to identify potential participants.

The tension between technical competence and clinical competence may best be observed in participants for whom this gap is most apparent—those new to the domain. The JIBC provides recruit training for both Primary Care (PCP) and Advanced Care paramedics (ACP). Students in the PCP program have variable backgrounds in emergency medical training, generally with limited experience in an ambulance setting. Thus, I chose to work primarily with PCP students in the study. However, I did stage several calls involving layered response with ACP crews. I recruited several ACP students to staff the ACP crew, and thus did observe the performance of ACP students in the HF environment.

While using a purposive strategy to identify the potential sample group, I employed a convenience strategy (Palys & Atchison, 2008) for recruiting actual participants from the PCP program at the JIBC, based on the locations the program was running at the time of the study and the number of students willing to participate. Participants from three cohorts of PCP students volunteered to participate in the study.

I chose to recruit preceptors with no instructional experience as the roles and functioning of the instructor and preceptor are significantly different. Classroom simulations are run by an instructor who controls the simulation, assesses the learners, and provides feedback. In contrast, learners in the practicum setting work on a functional ambulance that is crewed by a driver and an attendant. The attendant takes on the role of preceptor: guiding, coaching, and providing

feedback to the learner as the call progresses. The preceptor also evaluates and gives formal sign-off on the student's experiences and performance. As this study involved contrasting the interactions of instructors and preceptors, I felt it was important to use preceptors who would not revert to taking on the role of instructors in traditional classroom simulations.

Simulation Participants

An ambulance call is a social experience involving, at a minimum, a patient and an ambulance crew. I staged the HF simulations as practicum experiences, so each ambulance crew consisted of an attendant (student), a driver (student), and a preceptor (an experienced paramedic, functioning as an instructor/facilitator). In practice, ambulance calls rarely involve only four people. Patients are often surrounded by family members or friends. In many calls, particularly emergency situations, multiple agencies respond and there may be first responders (often fire crews consisting of two to six personnel) or police on scene. The calls themselves may occur in isolated settings, but are more frequently embedded in public spaces and a variety of bystanders or passers-by may be present. Thus, a wide range of people were required to stage the HF simulations. In addition, my initial conception of fidelity required simulations with increased role, interpersonal, social, and cultural fidelity. I required not only a large number of participants for these supporting roles, but participants who more accurately represented the variety in age, gender, ethnicity, social, and cultural backgrounds that paramedics encounter in practice.

I also required a number of support personnel to stage the simulation days and gather the data. These roles included research coordinator, data management person, moulage (make up), media technicians, camera operators, mannequin operators, and call managers (to prepare actors and scenes, and to provide information in scenarios that could not be replicated or recreated).

Recruitment of simulation participants. A total of 105 personnel were involved in

staging the simulations. I obtained permission from the Dean of the School of Health Sciences to recruit volunteers from faculty, staff, students, and friends to fill the roles of patients, family, bystanders, and support positions. Recruits from the JIBC's Police Academy volunteered to play the role of police officers on several calls. Firefighters attending an Emergency Medical Responder course attended several calls as first responders. Several students from the ACP program offered to function as an ACP crew for the New Westminster session. I approached the Canada Games Pool, situated adjacent to the JIBC's New Westminster campus, and recruited lifeguards to participate in a series of calls that were staged at the pool. In Kelowna, an instructor who was both a paramedic and a nurse took on the role of triage nurse. In New Westminster, the triage role was played by an ACP student. Another participant, the father of one of the Kelowna faculty, was a retired RCMP member and played the role of police officer in several simulations.

Staff and faculty from the JIBC's School of Health Sciences took on several support roles. Instructors functioned as call managers, setting up the physical location, prepping actors, and operating mannequins. The call managers also provided verbal information as required (e.g., providing vital signs such as blood pressures and pulses when these differed from the vital signs being taken on an actor). Another instructor provided moulage, using make up and theatrical appliances to simulate injuries and the physical appearance of various medical conditions. The School of Health Sciences multimedia specialist prepared cameras and microphones, gave tutorials to the volunteer camera operators, and downloaded video files. Another staff person functioned as clerical support. I recruited camera operators from JIBC media staff, the PCP students, and other volunteers.

Data

Creswell (2012) noted that data methods and choices are embedded in an interrelated web

of activities “aimed at gathering good information to answer emerging research questions” (p. 146). Factors that influenced the choices and use of data and methods of collection them included access to sites, gaining and maintaining a rapport with participants, and sampling strategies. In turn, these choices had implications for coding, storing, accessing, and interpreting the data.

I had available a wide range of potential data sources. The simulation environment itself was a rich source of information, from direct observation of the actions, interactions, and conversations of the participants to the documents associated with patient care and student evaluation. Additionally, I had access to student performance data for other simulations and for the program as a whole. I also had potential access to interviews and/or focus group sessions with the participants, the other actors in the scenarios (patients, bystanders, other responders), and those involved in administering the simulations. Other potential sources of data included questionnaires, surveys, journals, or other customized tools for collecting data either from the scenarios directly or from participants outside the simulation (e.g., reflective activities asking participants to think aloud about their actions and decisions). The actual selection of data was based on examining the research question and subquestions themselves and the type of information needed to explore those questions in relationship to what data sources were available. The following section outlines the sources of data that I collected and the processes I followed in preparing the data for analysis and interpretation.

Data Collection Methods

Creswell (2012) identified four categories of data collection: observation, audio-video recordings, documents, and interviews. I used each of these data types in this study.

My primary object of study was the actions and interactions of participants within the

simulation environment, particularly in relationship to the concepts of competence and clinical judgment. The use of overlapping data sources provides a rich set of perspectives from which to explore the object of study (Kincheloe & Berry, 2004). Thus, in addition to directly observing the activities in the simulation, I sought sources of triangulation (Merriam, 1988) that would allow me to explore further participants' lived experiences in this learning environment, including the decisions they made, what information they obtained from the environment, and how they made and defended those decisions.

Video recordings of simulations. The main source of data for this study was video recordings of the simulations. The video recordings allowed a visual and auditory record of the scenarios, the actions and interactions of the participants, and their ongoing conversations.

"All observation involves participation in the world being studied" (Denzin & Lincoln, 2011, p. 416). Video recordings provide empirical data, but are, at the same time, a form of recreation and representation (Denzin & Lincoln, 2011). Video recordings are an increasingly common form of data collection in qualitative research (Creswell, 2012). Observation focuses on what can be seen (Prosser, 2011), but what can be seen and heard on a video is a function of where the camera is positioned and what it looks at. Yet, simulations are dynamic environments involving interaction between multiple participants and elements of the scenario and the use of video in this study differed from that of recording interviews.

In prior unpublished research, I had tested the use of various video and audio points of view (POV) for assessing simulations. I placed cameras in static (fixed location, wide-angle view) and roving (handheld camera with an operator who could move at will throughout the scene) locations at ground level and above the scenario. I also used helmet cameras to record the scenario from the POV of selected participants. I created video clips from each of these POV.

Subsequently, instructors assessed the simulation by watching a video from various POV. No single POV captured an accurate picture of the unfolding of the scenario. Each POV was, at some point, blocked, or viewers were unable to view important aspects of the call. In addition, the roving cameras often did not pick up significant portions of audio. The instructors rated the two handheld cameras as the most effective (both the roving camera and the overhead camera used by an operator), although the helmet cameras captured the best audio.

Each of the HF simulations in this study was recorded by at least one video camera operated by a roving camera person. Each operator was assigned to a specific crew for the day. The attendants in the calls wore a wireless microphone to ensure that high-quality audio was gathered regardless of the positioning of the cameras. Camera operators were free to move as they saw fit to get the best view of the unfolding call. Each preceptor also wore a lapel camera which gave a second audio source and view. However, these cameras did not provide useful visual information. In addition, there were two extra cameras for the Vancouver HF simulations and one for the Kelowna session. These extra camera operators were free to choose which simulation they wanted to follow and provided supplementary POV and audio.

Document audit. "Nothing stands outside representation. Experience can be represented in many ways, including rituals, myth, stories, performances" (Denzin & Lincoln, 2011, p. 415). Several subquestions explored the participants' use of clinical reasoning and patient assessment activities. Their actions and conversations provided direct windows into their choices. In addition, the participants created multiple forms of narratives to describe their experiences. Narratives are "socially constrained forms of action [—socially situated] ways of acting in and making sense of the world" (Denzin & Lincoln, 2011, p. 415). The students' discussions with preceptors and instructors often focused on their decision making and rationale. Further, their

reports (both verbal and written) to other responders and health care providers and their patient care documentation form socially structured stories were designed to highlight what participants found, what choices they made, and the rationale for their actions.

Participants were asked to complete patient care reports (PCRs) for each of the calls that they performed. In field practice, paramedics use PCRs to document key assessment findings and treatment actions. Compliance was moderate, and I obtained PCRs for 30 of the 40 HF simulations in the study. Six of the HFS calls in New Westminster involved layered response with ACP crews. The ACP crews were not asked to complete PCRs and thus there was no patient documentation on those calls.

Documents also provided opportunities to explore preceptors' perspectives and feedback to the students. Preceptors were asked to complete practicum logs for the students they worked with. These were multipage forms on which preceptors documented student performance against evaluation criteria determined by the PCP program. I obtained five completed of potentially six preceptor forms.

Semistructured interviews. Norman et al. (2007) noted that traditional methods for exploring clinical reasoning such as *thinking aloud* and *stimulated recall* are often inadequate for exploring nonanalytic reasoning. Interviews, however, allow researchers to access more subjective aspects of the participants' experience (Peräkylä & Ruusuvuori, 2011). Kamberelis and Dimitriadis (2011) posed the functions of interviews as pedagogic engagement designed to achieve understanding of issues important to the group, while allowing the researcher to "achieve richer, thicker, and more complex" (p. 545) outcomes. Interviews, they claimed, explore *how* and *why* questions.

Focus groups foster collective engagement and higher levels of understanding by

generating “rich, complex, nuanced, and even contradictory accounts of how people ascribe meaning to and interpret their lived experiences” (Kamberelis & Dimtriadis, 2011, p. 546). Strategic interviews prompt focused dialogue towards themes that are important to the researcher; maintaining a semistructured approach “decenters the role of the researcher, promoting more dialogic interactions and the joint construction of more polyvocal texts” (Kamberelis & Dimtriadis, 2011, p. 560).

Within the context of this study, focus group interviews allowed me to bring students, instructors, preceptors, and other simulation participants together to explore collectively their experiences. I conducted semistructured interviews with a group of Vancouver students after their Classic Case simulations, the Vancouver students after the HF simulations, and the Kelowna students after their HF simulations. I transcribed these interviews for analysis. I chose to not conduct individual interviews with participants in the study. I already had significant amounts of data from the simulations and related documents in which participants explored, explained, and described their actions and decision making.

Follow-up interviews. In March 2010, students from Vancouver re-entered the practicum, almost a year after completing their classroom sessions. The JIBC developed a refresher program to prepare the students for the practicum environment. I was able to meet with six students for a follow-up focus group interview. The session was impromptu, and thus an unstructured interview, with questions focusing on issues that had emerged from my ongoing analysis of the data. This session served several functions. It served as an additional source of triangulation, allowing both the participants and myself to validate, confirm, or challenge my observations and interpretations (Creswell, 2012). I was further able to bring my own developing analysis back to the members of the study, allowing them to question or validate the accuracy

and credibility of my findings, as well as identifying themes I may have missed (Creswell, 2012).

Researcher journal. The researcher is an integral part of qualitative research, both as the primary instrument and mediator of data (Merriam, 1988). Ellingson (2011, as cited in Denzin & Lincoln, 2011) posed the researcher as a crystal, bringing together multiple perspectives to create a "tale told from many points of view" (p. 5). Thus, the researcher is responsive to the context of the study (Merriam, 1988), but also a part of that context (Davis & Sumara, 2006). This is both a strength and a weakness, in the form of unrecognized bias, of qualitative research (Merriam, 1988). Thus, I recorded and maintained a journal of my own personal observations, coding notes and memos, emerging interpretations, and discussions with individuals, peers, and participants throughout the design, data collection, analysis, and interpretation phases of the study.

Data Preparation

A substantial amount of data was generated in this study. Data preparation included sorting and editing audio and video files, transcribing, and collating documentation.

Video editing. I obtained between two and four video recordings of each HF simulation. I used Adobe Premiere Creative Suite 4 (www.adobe.com/ca/products/creativesuite.html) to create a collage video file for transcription and analysis. I created a wide screen video frame, which allowed me to put multiple videos into a single frame. I generally used the roving camera operator as the primary POV, placing it as the largest image in the centre of the collage. I then placed any supplementary views as smaller images. I added a title to the top of the collage and a running timecode at the bottom of the collage. After editing, rendering, and creating high-quality and compressed versions, I had 402 finished video files comprising 488 gigabytes of memory.

Transcription. I transcribed the videos to create a text-based description of audio and video data. However, the process of transcription necessarily involves selection, reduction, and

interpretation of data. My process of developing transcripts was, in effect, an initial form of interpretation in which I had to determine what information to put to the forefront, develop initial coding frameworks, and choose a unit of analysis.

Verbatim transcripts. I created verbatim transcripts for all interviews and debriefing sessions. All analysis of interviews was based on the verbatim transcripts.

I initially planned to create verbatim transcripts for all simulations and to use change of speaker as my primary unit for coding purposes. I experimented with different qualitative analysis software and chose Transana (http://transana.org/) as my primary option. Although several software packages worked with video, I found Transana's keyboard commands simple and effective for creating transcripts. Transana also allowed me to code directly from video clips and create collections of video clips that could be easily reviewed. In addition, the visual layout of the Transana screen presented information in a format that was easy for me to use and understand. I used Transana's visual output of coding to create individual maps of simulations that highlighted various coding structures.

I found the verbatim transcription of the calls to be a tedious and difficult process. By definition, the HF simulations created complex situations involving multiple participants and their interactions. I had audio from wireless microphones on the attendants and lapel microphones on the preceptors. Even so, it was often difficult to capture and understand many of the participants in the scenarios. Often several people would be talking at once. And at times, these overlapping voices were different groups of participants having different conversations. In addition, it was quickly apparent that the participants used a significant amount of nonverbal communication; their interactions were often as kinesthetic as they were verbal. Thus, the verbatim transcriptions provided a literal and linear record of the conversations that were audible

in the video recordings of the simulation. They were, however, difficult to create, necessarily incomplete, and lacked coherence and meaning as descriptions of the simulations.

Interaction transcripts. My next approach was to change both the focus of transcription and the basis for creating clips. I had found that the verbatim transcript simply did not capture the complexity and activity that was occurring in the simulations. I tried creating a narrative text that described the action and included verbatim conversation. However, as noted above, a simulated ambulance call is a rich, dynamic, social experience, and I quickly realized that any transcript was going to require selection, reduction, and interpretation of what I was seeing and hearing. Thus, I chose to continue analysis and coding by working directly from the media clips rather than text-based transcriptions. However, I created interaction transcripts that were a mix of narrative description and interpretation of what I was seeing in the videos along with selected verbatim elements. While I coded clips by watching the videos themselves, the interaction transcripts provided a descriptive account of each clip.

I used this framework to create clips and code two of each type of simulation. This process resulted in 70 to 120 clips per simulation. The level of granularity was fine enough to distinguish interaction between different sets of participants, while remaining large enough to be contextually coherent (Lincoln & Guba, 1985). I was able to pull out individual clips at random and recode them without needing to look at the clips preceding or following clips.

Documentation. I prepared PCRs, preceptor forms, and occurrence reports for analysis by scanning them and creating PDF documents. I collated the documents and cross-referenced them with their associated simulations. I was able to draw some basic descriptive statistics from the documentation as well as compare the participants' written reports with their oral reports.

Analysis and Interpretation

Creswell (2012) described three common structures for qualitative analysis: interpretive, systematic, and ethnographic. While each has differences, Creswell (2012) noted a general pattern in qualitative analysis of gathering data, coding, combining codes into broader themes, and then presenting and comparing findings in the data. I chose to employ a systematic general structure (see Huberman & Miles, 1983), while following Kincheloe and Berry (2004) in choosing specific analytic approaches that best suited exploration of particular subquestions and concepts.

My analysis consisted of six rounds or phases:

- First round: Descriptive analysis;
- Second round: Refinement of subquestions, analytic strategies, and tools;
- Third round: Initial analysis, working with the data;
- Fourth round: Identification and exploration of patterns, trends;
- Pause;
- Fifth round: Development of conceptual categories related to research question and goal; and
- Sixth round: Interpretation and discussion.

Table 3 relates these phases to Creswell's (2012) general phases of qualitative analysis and Huberman and Miles' (1983) systematic model.

Table 3. Phases of analysis and interpretation

Analytic activity in this study	Analytic Strategy (Creswell, 2012)	Systematic Qualitative Approach (Huberman & Miles, 1983)
Obtain video recordings, field notes	Sketching ideas	Margin notes in field notes
Initiate researcher journal	Taking notes	Write reflective passages in notes
First round: • Descriptive analysis • (see Chapter 4)	Summarizing field notes	Draft a summary sheet on field notes
Second round: • Refinement of subquestions, analytic strategies, and tools		
Third round: • Initial analysis, working with the data		
Development of theoretical codes	Working with words	Make metaphors
• Initial review and coding o Theoretical codes o Emergent codes	Identifying codes	Write codes, memos
See fourth round, below	Reducing codes to themes	Note patterns and themes
Creation of frequency count tables	Counting frequency of codes	Count frequency of codes
Additional theoretical and emergent analysis • e.g., narrative analysis of reports		
Fourth round (See Reducing codes to themes, above, left): • Identification and exploration of patterns, trends • Development of themes • Relate themes to research questions and subquestions • Articulation of findings in relation to research questions and subquestions (see Chapter 5)		
Pause: • Move from analysis to interpretation • Rereading of the data, findings, themes • Additional review of literature		
Fifth round: • Development of conceptual categories related to research question and goal • Analysis and interpretation of themes in relationship to conceptual categories	Relating categories	Factor, note relations among variables, build a logical chain of evidence
Articulation of findings and themes through conceptual categories (Chapter 6) • See Pause, above	Relating categories to analytic framework in literature	
Sixth round: • Interpretation • Relate conceptual categories to dilemma, practical problem, and research goal	Creating a point of view	Make contrasts and comparisons
Discussion and presentation (Chapter 7)	Displaying the data	

Analysis and interpretation in qualitative research are ongoing, iterative processes that

extend from initial planning and data gathering through to the final write up (Merriam, 1988). I maintained an ongoing journal throughout the study and began investigating concepts and strategies for organizing, analyzing, and interpreting data while developing the initial HF scenarios. This process continued as I gathered, organized, and prepared the various forms of data for analysis.

The process of data preparation also shaped my subsequent analysis. My primary analytic approach involved coding the videos and the interview transcripts. As noted above, I chose to code directly from the video clips rather than from transcripts. Through preparation of the videos, transcripts, and other forms of data, I began to notice trends, similarities, differences, and interesting features. I continued to record these initial impressions and insights in my journal.

I prepared for in-depth analysis by reviewing all videos and re-reading all documents and transcripts as part of an ongoing "conversation with the data" (Merriam, 1988, p. 131).

First Round: Descriptive Analysis

After gathering and preparing the data, I moved to a process of descriptive analysis. The simulations in the study consisted of at least three distinct types of learning environments with varied structures, activities, and patterns of interactions between participants. The goal of this initial analysis was to develop a detailed description of the cases and their settings (Merriam, 1988), and to dissect the environments, "uncovering, defining, and analyzing [their] elements and essential structures" (Denzin, 2001, p. 355). I identified areas of similarities and differences, as well as convergence and divergence (Merriam, 1988). Several themes emerged, relating structural and functional characteristics of the different environments with their respective instructional goals. Chapter 4 presents an analysis of these simulation-based learning environments in terms of pedagogical intent, structure, pedagogical approach, and fidelity.

Second Round: Refinement of Subquestions, Analytic Strategies, and Tools

Eisenhart and Jurow (2011) noted the importance of narrowing of the initial research focus to avoid being overwhelmed by the volume of data generated in case study research. And this study generated a substantial volume of data. Thus, I developed an initial, tentative analytic strategy through analysis of the research question and identification of a series of subquestions (Eisenhart & Jurow, 2011). These subquestions focused on the interactions and relationships of the participants with each other and selected elements of the simulation environment. I entered the study with a set of working conceptual definitions, and thus I chose to employ both theoretical and emergent coding strategies (Creswell, 2012) as my primary analytic approaches. As I refined the subquestions, I developed different types of data, alternate methods of analysis, and selected both specific cases and specific elements of different cases which were relevant to the subquestion at hand (Kincheloe & Berry, 2004).

Several questions called upon theoretical constructs that informed the study. For example, I entered the study with a conceptual understanding of fidelity as a series of nested relationships involving presentation of the patient (physiological fidelity), location of the call (environmental fidelity), and authenticity or naturalness in the manner in which participants performed functions and activities (procedural fidelity). Similarly, I understood the simulation environment as a series of overlapping and interacting phenomena including the patient, physical environment, partners, equipment, instructors/preceptors, and other participants. Using these working definitions, I created tentative coding frameworks (Eisenhart & Jurow, 2011) to address the first subquestion: What and with whom do learners interact in a high fidelity simulation-based learning environment, and how do they interact with them? Thus, I employed a theoretical coding approach for some subquestions (Creswell, 2012). Other subquestions, such as “How do learners

perceive and describe their own sense of clinical judgment after high fidelity simulation-based experiences?" implied no a priori conceptual model and were more suited to emergent coding.

I refined the subquestions to develop additional analytic tools and approaches. I created tables with which to assess the students' performance against evaluative processes from the current curriculum and to analyze the structure and content of participants' documentation and reports. I developed the criteria for these tables by modifying existing evaluation checklist criteria. I developed assessment tools to look for markers or evidence of clinical reasoning strategies based on the literature, such as the use of semantic qualifiers, diagnostic terminology, key features, feature matching, etc. I called upon my model of interaction and the steps in the paramedic patient assessment model to create tables for assessing where and from whom participants obtained information in the environment.

At the same time, I realized that these tools and approaches were tentative, and I remained open to modification based on insights, patterns, and relationships that emerged from the data.

Third Round: Initial Analysis and Working With the Data

I began in-depth analysis by reviewing the data from the study. Some simulations had poor quality video and/or audio. Others had limited relevance to the study. I chose an initial sampling of Core Skills, Classic Case, and HF simulations for in-depth analysis based on their potential to provide insight into the questions of this research. These concentrated cases (Palys & Atchison, 2008) included simulations in which there were rich and accessible empirical data. I selected simulations that sampled both typical and maximum-deviation cases. I did not seek cross-case comparison of specific preselected variables, nor was I focused on validating or exploring the representativeness of my initial categories. Thus, I did not employ quota or

identical case strategies (Palys & Atchison, 2008).

I initially coded two simulations each from Core Skills, Classic Case, and the HF module. I used this process to refine my initial theoretical codes and to begin to identify potential emergent themes. Early coding focused on the interactions and procedural fidelity of the participants in the simulations. I broke each simulation into clips based on units of interaction (distinct segments of activity or conversation around a single idea, action, or process). This level of detail met Lincoln and Guba's (1985) suggestion that the analytic unit be the smallest element that could "stand by itself" (p. 345) while still being relevant for interpretation. I added codes to each clip based on my initial coding structure. I gathered individual clips focused around emergent themes, topics, or analytically interesting features into collections for further analysis. I continued to journal my impressions, emerging ideas, and ongoing thoughts.

Following an inductive, theory-generating process, I modified, abandoned, or added themes and factors based on emergent trends during analysis (Creswell, 2003). I began refining my coding structure and categories almost immediately, both in terms of codes that were rarely used and codes that were too broad. For example, my initial codes included cultural and societal factors. I found that the participants rarely, if ever, engaged with these factors in the calls. In contrast, I had initially used "injury/condition" and "patient" as two codes for noting interactions of the attendant. Over time, these initial codes expanded to better reflect the richness of interactions of the attendants with their concept of the injury or condition, their encounter with the patient as an instance of that injury or condition, and interactions with the patient as a person beyond injury condition.

Emergent codes. In addition to my initial theoretical codes, I identified clips and created collections of clips that I found analytically interesting or relevant to my research question and

subquestions. These convergent elements formed the basis of creating new coding categories, while analysis of the elements led to the divergent process of differentiating between characteristics or "fleshing out the categories" (Merriam, 1988, p. 135). I developed new coding tables from this process that extended analysis and investigation beyond my initial set of subquestions and coding tables. I developed emergent coding structures to explore factors such as the ways in which preceptors and instructors coached and gave feedback to the students, the types of activities that the participants engaged in during the simulations, how they structured information in their reports and discussions, and the apparent sources of authority or rationale used by instructors and preceptors when giving advice or correction.

Additional theoretical and emergent analysis. As I worked through the coding process, several new categories and themes emerged, prompting new subquestions requiring a variety of strategies for analysis. For example, I had collected instances of participants giving their reports to the triage nurse at the hospital. I noticed that the reports themselves were quite varied in terms of structure, complexity, and apparent intent. This led to refinement of the initial subquestion ("How do learners structure and present their descriptions of their experiences?") to ask how the reports reflected participants' domain knowledge and use of clinical reasoning strategies. This, in turn, led to development of new codes that examined the structure of the reports, the richness of detail, inclusion of specific data from the calls, and presence of evidence suggesting use of specific clinical reasoning strategies. I developed a series of assessment tables listing analytic criteria and their presence or absence in the reports. This process allowed for comparison of data across instances and the identification of new trends and themes (Merriam, 1988). I used a similar strategy to refine and analyze research subquestions such as what types of feedback preceptors and instructors provided students, where and from whom students gathered

information, and assessment of students' performance in the simulations.

Several new categories emerged through examination of clips which resisted coding, or which were negative instances of common phenomena (Creswell, 2012). I maintained collections of these difficult-to-code clips. In some cases I gathered enough clips with similar characteristics that entirely new phenomena became apparent. For example, while coding clips for *cognitive focus* or the degree of apparent immersion of participants during a simulation, I began to encounter scattered instances of *aporia,* when participants would literally disengage from the simulation in confusion. Enough instances of this phenomenon occurred that I was able to distinguish several types of aporia. In other cases, the clips appeared to be single instances of a phenomenon or were simply clips that were difficult to code.

This phase also highlighted one of the challenges of using pre-existing theoretical coding frameworks. One of my initial coding categories classified feedback given by instructors and preceptors against the Patient Assessment Model. I was able to code instructor feedback using the codes, but the preceptors' comments simply did not fit easily. However, an analysis of the preceptor feedback in relationship to the Dreyfus (2001) model of skill acquisition led to development of a more robust emergent category, which was a better fit to the data (Glaser & Strauss, 1967).

Fourth Round: Identification and Exploration of Patterns and Trends

The development of the subquestions and methods for their exploration was a reflexive process in which the results of one phase of analysis prompted modification or new subquestions for further analysis. Thus, my initial list of findings and statements were linked by my research question and subquestions and initial conceptions as well as an emergent and experiential trail. While I used several analytic strategies, calling on different conceptual models, the data that

were generated were organically linked. The refinement of my subquestions and the development and selection of methods for analysis were informed by ongoing readings from critical discourse, narrative analysis, clinical reasoning, and expertise literature.

I employed a variety of strategies or "tactics" (Merriam, 1988, p. 148) for deriving meaning from the data (see Chapter 5 for an in-depth discussion). I used frequency counts, for example, to note that instructors and peers tended to give feedback directed to Dreyfus' (2001) categories of novice and advanced beginner, while preceptors' feedback was more often targeted towards fostering proficiency and expertise. In other cases the development of the categories was indicative of emergent trends or themes that, themselves, were insights gained from analysis (see, for example, codes describing the functions of *miming* and *mirroring* in Chapter 5). As noted above, the coding process led to increasingly fine discriminations and the development of new codes and categories, as well as the collapse or consolidation of other constructs. My analysis software created maps which allowed me to visualize, compare, contrast, and draw inferences from multiple coding constructs. Using these maps I was able to see potential relationships between, for instance, procedural fidelity and sense of immersion. I also created visual maps relating facets of the simulation experience to conceptual models, such as comparing who and where participants gathered information from during specific phases of patient assessment.

I continued to enfold relevant literature with my ongoing analysis and interpretation throughout the study (Eisenhart & Jurow, 2011). I called upon several theoretical and conceptual models in this process. My initial analysis drew strongly from clinical reasoning literature and curriculum concepts from EMS education. However, I also called upon multiple perspectives to develop richer meaning from the data (Eisenhart & Jurow, 2011; Kincheloe & Berry, 2004).

Thus, when my initial coding of how participants structured their hospital reports provided unsatisfactory results, I looked to Riessman's (1993) process of narrative analysis to uncover narrative structures that differentiated the sophistication and degree of interpretation of the participants' stories. Similarly, a richer reading of Dreyfus' (2001) skill acquisition model provided more nuanced analysis of how instructors and preceptors foster different learning outcomes. The juxtaposition of Schön's (1983) and Klein's (1997) phenomenological approaches to problem solving in professional settings with clinical reasoning literature was useful in both considering clinical judgment (in the context of EMS) as more than clinical reasoning and in developing coding categories that acknowledged the importance of context in decision making.

Articulation of findings. I next created a spreadsheet listing my research question and subquestions. I then went back into the data and developed statements that described my analysis of the findings for each subquestion. The data statements included summaries and analysis of statistical data (such as "none of the triage reports followed the formal reporting format exactly"; "14/30 reports included an implied or explicit provisional diagnosis"), insights that emerged ("narrative structures in the reports indicate the use of clinical reasoning strategies"), themes ("interaction of attendants with mental constructs of illnesses, patients as instances of those conditions, patients as individuals with a life and health history, patients as people embedded in social and cultural milieu"), and emergent concepts ("preceptors and instructors call upon different sources of authority to support their feedback"). These statements became the data elements that I worked with in subsequent analysis and interpretation. I found that some questions generated multiple findings. Others, however, exposed gaps in the data I had generated. In some cases, I attributed this to dead-ends in the process—routes of exploration that simply led away from the understanding that emerged along other paths. In other cases, I saw

possibilities for further exploration. I made note of these areas for further study.

The results and discussion of this analysis are presented in Chapter 5.

Pause

At this point, I moved from a focus on description and analysis to an inductive process of interpretation. While the individual statements and findings had meaning in themselves, each also contributed to the overall research question and goals. The process of interpretation in qualitative research involves "abstraction beyond the codes and themes to the larger meaning of the data" (Creswell, 2012, p. 187). Juxtaposition of multiple evidence and perspectives, particularly in relationship to broader concepts or research goals, leads to novel insights and the development of theory (Creswell, 2012; Eisenhart & Jurow, 2011). I worked with an iterative, inductive process of relating the individual themes and statements of finding to the overall research project to develop a series of conceptual categories (see Chapter 5). I then further abstracted the results of that discussion with relevant literature to address more broadly the dilemma and practical problems that spurred this study (see Chapter 6).

The following sections describe the development of themes from the findings and data—conceptual categories from which to discuss the findings, and articulation of relationships among concepts that moved over and through the findings (Creswell, 2012). The actual processes of analysis and interpretation overlapped and informed each other. Many of the themes identified below began to emerge early in the analysis process. Consideration of the emergent categories led me to re-engage and recode segments of the data, or to refine my codes and their descriptions. The following narrative should be considered more of a remembering and reconstruction of the phases of interpretation than a chronological listing of its steps.

Fifth Round: Development of Conceptual Categories Related to the Research Questions

I began the process of interpretation by performing a chronological re-reading of my journal and notes. I then gathered the coding tables I had developed and read through the definitions and categories. I reviewed the various assessment tables I had created. I had built a number of collections of clips tagged to specific themes and analytic categories. I watched through each of these collections.

Articulation of themes. I had noticed concepts and themes developing in the data as I worked through the coding and analysis process. I maintained a journal through this process and used this as further data in my interpretive task. The coding process is, of necessity, a reductionist task—the breaking apart of experience into segments for description, comparison, analysis, and interpretation. Yet, the meaning I discerned in these segments is embedded both in the experience from which they were drawn (the simulations the participants were engaged in) and the larger processes of my research study. The codes that I developed related each segment to other aspects of the simulation (e.g., phase of assessment or management being performed), to similar activities in other simulations (e.g., as examples of coaching by preceptors), and to emergent themes in analysis and interpretation (e.g., noting the source of authority to which a preceptor was calling upon when giving feedback to the students). The impressions, observations, ideas, interpretations, and questions that I noted in my journals further linked individual bits of data and my overall experience of the research process. Thus, I constantly cycled reflexively between the data and my research questions, seeking meaning through consideration of the data within the context of the whole experience (Gadamer, 1975; Kincheloe & Berry, 2004; Merriam, 1988).

I developed a series of provisional themes with which to categorize the various data. I

began my articulation of these themes by returning to my initial research question and subquestions and asking how the individual data related back to these questions. I had noted several themes and categories in the data during initial analysis. Some of these emerged from the coding categories and comments from my research journal. Others emerged from reading across the data elements. Still others were sparked by theoretical concepts from ongoing reading of clinical reasoning, naturalistic decision making, narrative analysis, and complexity literature. I categorized the data statements into the themes. As new themes emerged, I examined them against previous data sets. Many of the findings wound up categorized into multiple themes.

I refined and revised the initial set of themes. The intent of this inductive process was to develop a theoretical understanding that responded to and informed my research question and subquestions. Thus, I maintained and extended themes that arose frequently in the data ("discernment"), provided understanding towards one or more of the research topics ("tunnel vision"); or provoked interest or explored a unique or unanticipated aspect of the research ("situational and divergent nature of feedback from preceptors"). At the end of this process I had 32 themes.

Conceptual categories. My next round of analysis and interpretation sought a more abstract conceptualization and synthesis of these themes (Creswell, 2012). I returned to my primary focus—fostering clinical judgment of paramedic recruits in immersive HF simulations—as a lens for synthesizing and conceptualizing the findings and themes. This process led to a series of conceptual categories that I framed as statements about how simulation is related to decision making, learning, and teaching, and to their underlying epistemological and ontological assumptions. These categories were phrased as "how" and "what is" statements; for example, how teaching and learning occur in simulation settings, what is considered real in simulation, and

how decisions are made in simulation. The conceptual categories provided an opening for investigation of the themes (and the underlying data from which they had grown) and a context for further interpretation and discussion that are the basis of presenting my findings in Chapter 5.

Sixth Round: Interpretation and Discussion

The final phase of analysis and interpretation for this study involved a restatement or reconceptualization of core concepts that relate the themes and findings to an exploration of how HF simulation might be employed in a curriculum to foster the development of clinical judgment in paramedic recruits. The previous listing of conceptual categories emerged from analysis and synthesis of the data and themes. However, as I worked with these categories, I noticed other relationships that cut across the themes. I noted changes in the way I used core concepts and terms that inspired and informed the study. These themes were like nested relationships between varying findings that emerged as a synthesis that spoke to the overall research question and subquestions of the study, the dilemma that inspired the research, and the practical problem it sought to address.

The exploration of these relationships provides a reconception and extension of several core concepts in this study: the progression of learning, fidelity, mental constructs, different ways of knowing, discernment, and fostering the development of clinical judgment. Chapter 6 extends past the research question in isolation and explores these thematic categories in relation to the goal, dilemma, and practical problems that inspired this study.

Bias of the Researcher

"All research is interpretive; it is guided by a set of beliefs and feelings about the world and how it should be understood and studied" (Denzin & Lincoln, 2003, p. 33). I entered this study as a former paramedic, paramedic educator, and curriculum developer. I am familiar with

the particular cultures of both field and educational practice in paramedicine. While this background was useful in the design and execution of the study, it also coloured my analysis and interpretation. I necessarily brought my personal and professional biases and preconceptions into this work. My research was situated at an intriguing intersection of my professional careers. I have been involved in EMS and the emergency services since 1979. I have also been an instructor in first aid, health, safety, and rescue almost as long. I came to the JIBC as an instructor in 1992, and I quickly moved into educational management, then curriculum development roles. In the late 1990s I completed a diploma and a bachelor's degree in adult education. In the early 2000s I worked through a master's degree in educational technology. In 2006, I formed an applied research group within the Paramedic Academy as part of an institutional strategic push into degrees and applied research. I helped develop and further the academy's vision of advancing the profession of paramedicine within an evolving health care system. My doctoral studies fit into a broader research agenda that I have been developing at the JIBC based on my interest in the use of technology in education through the development of immersive HF learning environments and learner-centred assessment and evaluation methods. This work speaks to my interest in curriculum and the need to move from closed curriculum models to more open-ended and complex conceptions of curriculum as a potential space of guided exploration. This research was set within the professionalization of paramedicine in Canada and the demands that such a goal places on its educational systems and models.

Limitations and Delimitations

I situated this study within an immersive HF simulation environment in the context of recruit paramedic education in British Columbia. I defined fidelity as the intersection of a number of factors and relationships that are part of a simulation environment. This study focused

on elements that I considered important to the research question and subquestions. Fidelity is a complex construct, however—neither simple nor static. Distinctions in medical education literature between low, medium, and high fidelity often revolve around the fidelity of the mannequin (see, for example, Bradley & Postlethwaite, 2003; Kneebone et al., 2006). Gaba (2004) identified 11 domains to consider in the construction of simulations, while Kim et al. (2007) listed 17 attributes of case construction that can be subsumed into five characteristics. Different researchers may choose a different blend of elements or factors that better suit their purposes.

I restricted my research to practice learning activities set within paramedic education. I looked quite deliberately at a series of short drills and full-call simulations. I neither defined nor included data from other forms of practice learning activities such as skill stations or OSCEs (Objective Structured Clinical Encounters). Neither did I consider other forms of practice learning common to other disciplines, such as role plays, multi-participant scenarios, or disaster exercises. I did not include computer-based or paper-based case study or simulation. While this study raises interesting questions about calls in a field practicum as a type of simulation, I also chose not to deal with workplace-based apprenticeship experiences.

Several limitations are important to note. In my initial research design, I had planned on having ambulances as part of the scenarios. The transportation phase of an ambulance call is normally verbalized in classroom simulations. New recruits often comment that they are surprised at the length of time that they have to interact with and care for patients in the field. Unfortunately, due to job action, I was not able to access ambulances for either of the HF simulation days. Thus, a significant element of field calls was not included in the simulations. This was mitigated somewhat in the New Westminster simulations by the fact that the crews had

to transport the patient by stretcher from calls situated across the campus. Thus the students did have additional time with their patients. In Kelowna, mock ambulance areas were set up in the gymnasium. Crews moved their patient to the mock ambulance, then simulated being in transit before unloading and moving the patient to the triage area.

My intent to collect documentation from the calls was thwarted by the current operational climate in the local ambulance service. The students did complete PCRs (patient care records) for most calls—the exception being layered response calls in which an advanced life support crew took control of the call and the students moved to a support role. However, the preceptors, as part of the ongoing job action, either would not complete preceptor forms for the students or tended to document very lightly. While I was unable to gather data from what I perceived as a potentially rich and valuable source, I did gather important data on how practitioners' desire and ability to subvert the dominant authority's policies may be passed to subsequent generations.

The job action also impacted my ability to have the participants complete a learning journal, reflecting on their experiences in the HF simulation environment and their move to the practicum settings. The students were unable to resume their practicum for a full calendar year.

Validation Strategies

Kincheloe and Berry (2004) approached questions of rigour and validation in qualitative research as an attempt to "distinguish between worthy and unworthy knowledge" (p. 14). Merriam (1988), writing within the context of case study research, noted that effective research must be believed and trusted. While evaluation of research grounded in the natural sciences tends towards evaluation of methodological rigour, researchers in qualitative traditions take a variety of approaches to validation (Creswell, 2012).

Creswell (2012) stated that qualitative researchers strive more for understanding than for

generalizable principles or theories. Kincheloe and Berry (2004) noted that assessment of socially constructed knowledge does not rely on concepts of internal and external validity, or the adherence to the steps in a predetermined research process. Rather, the creation of knowledge is embedded in "multiple layers of intersections between the knower and the known, perception and the lived world, and discourse and representation" (Kincheloe & Berry, 2004, p. 78). Assessment of the validity and rigour of research, for Kincheloe and Berry (2004), must acknowledge "the dynamic relationships connecting individuals, their contexts, and their activities" (p. 79). Similarly, Merriam (1988) reflected that research involving people, people's behaviours, and people's understanding of the world attempts to study that which is always "in flux, multifaceted, and highly contextual" (p. 171). Thus, Creswell (2012) proposed validation as an ongoing process that emphasizes the interrelatedness of the research, the research participants, and the interpretation or representation of the research.

Based on a review of multiple strategies and techniques, Creswell (2012) presented a summary of eight common validation strategies: (a) triangulation; (b) member checking; (c) peer review or debriefing; (d) negative case analysis; (e) rich, thick description; (f) clarifying researcher bias; (g) external audit; and (h) prolonged engagement and persistent observation. Creswell (2012) acknowledged a variety of perspectives and approaches to validation, noting that researchers must choose validation strategies that are appropriate to their research. He noted that qualitative researchers should employ at least two of these validation strategies.

The concepts of triangulation, member checks, and peer debriefing were deeply embedded in the design of this study. I employed multiple data sources, used insights gained from one research question to inspire or inform analysis of others, and viewed the objects of study from multiple methodological and theoretical perspectives. For example, I gathered

descriptive data to investigate use of clinical reasoning strategies in the reports that students gave to the triage nurse. When this data source showed that students were not following the reporting strategies they were taught, I used concepts from narrative analysis to uncover narrative structures in the reports that did indicate use of clinical reasoning. I returned to the videos and transcripts to compare these reports with what information and processes the students used during the simulations themselves. I compared my analysis of the sources of information from the students with both their hospital reports and the debrief discussions with their preceptor after the call. In addition, I conducted a follow-up interview with the Vancouver cohort students and initiated informal discussions with colleagues to further explore my emerging understanding of how learners used their hospital report to structure and describe their experiences in the simulations.

I consulted frequently with colleagues as I developed the framework for this study, gathered the data, and worked through the processes of analysis and interpretation. My initial concepts of clinical judgment and fidelity emerged from research with exemplar paramedics in Canada, Hong Kong, and Singapore. The design and focus of the HFS day was a collaborative endeavour with colleagues from both the Paramedic and Police Academies at the JIBC. I had a small group of peers—faculty from the JIBC and the University of Alberta, Augustana—that provided support and insight throughout the research process. This group helped me explore, extend, and elaborate both in discussions and in review of writings that emerged in the study. I further explored my ongoing analysis and developing understanding in a focus group session with the New Westminster HFS participants six months after the HFS day. And I continue to bring aspects of the study back to practical application within my work.

Other validation strategies are also incorporated in this work. I have explored and

declared my understanding of my position and bias in relationship to the study both in my dealings with the participants (through information letters and during initial meetings to describe the study) and within this thesis. Further, I have provided thick, rich description in the presentation of findings in Chapters 4 and 5. Throughout the thesis, I also present examples and description to support my impressions, analysis, and interpretation. I continually bring forth the voice and experiences of the participants in this study. In addition, negative case analysis played a role in enriching my analysis of students' use of narrative structures in their reports, exploring differences in feedback given by instructors and preceptors, and attempting to understand instances where participants cognitively disengaged from the simulation experience.

Creswell (2012) cited Howe and Eisenhart's standards for evaluating qualitative research: Do the research questions drive data collection and analysis? Do researchers apply data collection and analysis techniques competently? Do researchers make explicit their assumptions and subjectivity? Are the study and its results robust, and does it use respected theoretical explanations? Does the study have value in informing or improving practice?

This dissertation documents my assumptions and theoretical framework and provides a description of my methods, decisions, findings, and interpretation. I followed a structured approach to qualitative research, using analysis of the research question and subquestions to inform analytic choices and procedures. I drew upon respected theoretical perspectives from clinical reasoning, decision making, and experiential learning literature to inform my analytic and interpretive decisions. I have provided, in this thesis, an audit trail describing my assumptions, decisions, and developing perspective. The results of this study are already informing practice within local and Canadian EMS education. The JIBC has formally incorporated the HF module into its PCP program. In addition, the model of fidelity has formed

the basis and has supplied substantial language to a recently published appendix to the *NOCP* (PAC, 2011), which allows EMS programs to use HFS as a supplement to the practicum experience. This new policy formally incorporates HFS into certification processes and will have positive practical impact on programs.

Chapter Summary

I used mixed methods in this research to situate and explore the interactions of participants and other elements of simulation-based learning environments. I gathered data from observation, video recordings, documents, and interaction transcripts of three types of simulation experiences. I also gathered data from post-simulation, post-day, and six-month post-course interviews with participants. The emergent form of this study is consistent with Kincheloe and Berry's (2004) call for a reflexive, multivocal approach to research, allowing me to pursue multiple perspectives in developing an understanding of how learning emerges in simulation environments. My research is deeply embedded in the context of paramedic education, and I employed a variety of methods to check and validate my findings and interpretation with the community with which I engaged.

The following chapter presents my findings and initial analysis of data, organized and represented through the lens of six conceptual categories that speak to aspects of epistemology and ontology, learning, teaching, engagement and interaction, and decision making in simulation environments.

CHAPTER 4: THREE FORMS OF PARAMEDIC SIMULATION

The first three chapters of this thesis outlined the questions, context, and conduct of my research. I turn, now, from data to discovery through a process of description, analysis, and interpretation. In Chapter 4, I work from my data back towards my research question and the puzzle that inspired it. I begin my reconstruction and representation of the study findings with a descriptive analysis of three types of simulation environments I encountered in the study. In later chapters, I build on this analysis to examine the conceptual and thematic categories that emerged from my analysis.

Simulations are learning environments—constructed experiences through which learners engage with each other and the environment, and apply ideas and actions to meet specific learning goals. These goals may include practicing the steps of a procedure, using that procedure to solve a problem, adapting a previously learned approach to a new setting, or finding new ways of doing things in unique or unusual situations. These varied learning goals require different environments calling upon a variety of teaching and feedback strategies. I focus, in this chapter, on the pedagogic characteristics and elements of fidelity found within the simulations of this study.

I found that the simulations in this study represented at least three distinctly different learning environments: short scenarios (Core Skills drills); longer, full-call simulations staged both in classroom settings and around the JIBC campus (Core Skills and Classic Case simulations); and rich, immersive simulations that involved multiple personnel and environmental factors (HF Simulations or HFS calls).

In the following sections, I present examples of these three types of simulations. I provide a description and transcript of a segment of each type of simulation, then analyze each in terms

of its pedagogical intent, structure, pedagogical approach, and aspects of fidelity:

- Pedagogical intent (location in the curriculum, specific learning objectives, and focus);
- Structure (length, components, mechanics: physical location, participants, set up, team/group composition);
- Pedagogical approach (role of the instructor, assessment/evaluation framework, feedback, and documentation); and
- Fidelity (physiological, procedural, environmental, role, and curricular).

Table B1 (see Appendix B) provides a summary of the characteristics of these three simulation environments. The following discussion draws on and explores the relationships identified in the table.

Case: Core Skills Drill

I captured data from two forms of Core Skills simulations: drills and uncomplicated full calls. The three Core Skills courses occur early in the PCP program. The goal of these courses is to help learners establish a cognitive and procedural framework for performing an ambulance call (the Patient Assessment Model or PAM) and develop the essential skills and procedures of paramedic practice. A typical lesson in the Core Skills starts with a demonstration of a particular procedure, followed by presentation and discussion of relevant anatomy, physiology, and pathophysiology. Learners then discuss the indications and contraindications for the use of the procedure and review its steps. Any new skills, such as learning how to start a peripheral intravenous line, are first practiced in skill stations under close supervision, then applied in a series of drills. Finally, after several lessons on related topics, the students practice integrating these procedures in performing uncomplicated full-call simulations.

Transcript of a Core Skills Drill

The following excerpt is from a transcript of a Core Skills 220 simulation (simulation: Vcr2_220_03). Please note that I have left participant quotes verbatim in all transcripts to

preserve voice and maintain readability. In this simulation, the instructor conducted a drill on managing epistaxis (nosebleed). The drill occurred during a lesson on hemorrhage management in Core Skills 220.

Excerpt from transcript Vcr2_220_03_05202009:

PCP 1: Student playing the role of the attendant
PCP 2: Student playing the role of the driver/partner
PCP 3: Student playing the role of the first responder
Patient: Student playing the role of the patient
Instructor: PCP instructor who is acting as the call manager (providing information as required) and evaluator (coaching and providing feedback)

The video clip opens with a medium shot focused on a young woman wearing dark blue cargo pants and a blue T-shirt standing, leaning forward, supporting herself against the back of a chair (see Figure 7). She is standing on what looks like a yoga mat. Several other participants are visible, all dressed alike. Other participants are leaning against chairs on other mats. The rest of the participants are looking to the left at someone off camera. The room is large—large enough to seat 40 students if the chairs and lecture tables were not piled up along the walls of the room. Orange jump kits (large rectangular bags with shoulder straps that paramedics use to bring their essential tools and equipment into a scene) and oxygen cylinders in red carrying cases are next to the mats.

Figure 7. Classroom setting for a Core Skills drill.

Instructor (off camera): You guys can . . . your patients are a little pale. Okay. Uhm, they are alert when you come in. You can see them kind of go “okay” and . . . and what you see is there’s some blood around the face and like it’s a . . . pretty good stream of blood coming out. It’s bright red. Uh, not gushing, it’s not spurting all over the place, but it’s a pretty good stream. Okay?

A young male stands behind the patient, turned to face the off-screen instructor. He has a jump kit in his hand. He listens to the set-up information from the instructor, then holds up his free

hand, indicating he has a question.

PCP 1: Can we put a 35A in the bathroom? Is there lots of room to work? Or? . . .
Instructor (off camera): Uhhhhhh . . . you can get it close by.
PCP 1: Okay. Great.
PCP 1: All right. So I can . . .
PCP 1: <Turns towards patient. Holds up his left hand, fingers curled, and extends his left thumb.>
PCP 1: Hazards.
PCP 2: (off screen) Blood.
PCP 3: (off screen) Cameras are rolling.
PCP 1: Oh. Okay. <Turns towards Instructor.>
Instructor (off camera): There's blood splattered all over but there's no plug in [the sink]. It's hard to tell if …
PCP 1: Environment <Extends index and middle finger.> Mechanism? <Extends ring finger.> No? Just the one [patient]? Good. <Lifts his left hand in the air.> Got my PPE[9] on. All righty . . . Help?
PCP 3: (off screen): First responder. If you need me.
PCP 1: All right, got a first. . . . great . . . general impressions? Know what's going on? I guess I heard that.
PCP 1: <Walks around to face patient.> Hi, Shea? Did you fall and hit your head or anything like that?
Patient: No.
PCP 1: I see your nose is bleeding.
Patient: It's just my nose is bleeding.
PCP1: Okay, your neck; your back? You having any trouble breathing or anything like that?
Patient: No.
PCP 1: <Drops jump kit. Moves closer to patient and reaches out with his right hand to check the radial pulse at her left wrist. Looks up at the camera and camera operator.> Do I have a radial pulse? I guess I do.
PCP 1: <Looks at partner who is standing just off screen.> Could you grab a little. . . . Nausea stick [inaudible]. We're just going to [inaudible] her. <Turns back to the patient.> How long has this been going on, Shea?
PCP 2 <Comes briefly into camera, then leans down to the jump kit on the floor.>
Patient: About 20 minutes . . . yeah.
PCP 1: Yeah? So, any trouble breathing or anything like that?
Patient: No . . .
PCP 1: <Moves to front of patient and lifts his hands towards her face.> I'm just going to check you over for any injuries. <Stops and turns to look at partner.> Could you get the 35A in here, too. We're just going to sit you . . . not a sandwich . . . just something . . .
PCP 2: Oh . . . You want me to go get it?
PCP 1: <Looks off screen to PCP 3.> Yeah, we're just going to visualize it. The 35A. You can go sit down now. <Motions towards the side of the room.>
PCP 1: <Moves back towards patient and stands behind her.> We're just going to get you sitting on this, okay—just sitting up.

[9] PPE: personal protective equipment; gloves, in this case.

Patient: Oh, okay. <Turns to move to the direction indicated by PCP 1. She turns the chair she was leaning against and sits in it.>
PCP 1: Sitting up, leaning forward. Okay. If you crash, we'll get you down there. <Points towards the ground.>
Patient: Okay.
PCP 1: Okay?

Pedagogical intent. This drill occurred as part of a lesson on hemorrhage control. The learning objective for this lesson is to "assess and manage bleeding using PCP procedures and equipment" (JIBC, 2005, p. 66). The learners have studied the signs and symptoms and memorized the steps for managing bleeding. Most of the procedures used in this activity have been previously learned in prerequisite courses and recently practiced in skill stations. The intent of this scenario was to practice applying those procedures in the role of paramedics in the context of an ambulance call. The instructional focus was on *mastery* (defined as performing procedures correctly, quickly, and without prompting) and *sequencing* (integrating the steps of hemorrhage control with the activities of conducting a Primary Survey).

Structure. This simulation was set up as a classroom-based drill in which multiple groups of students performed the same scenario in the same room at the same time. The instructor worked from a one-page script that identified the problem and gave succinct information on the background, findings, and expected actions that students should perform. The students worked in groups of three or four, rotating through the roles of attendant, driver, patient, and bystander/first responder. The drill format allowed the instructor to present identical information to all groups and to monitor their performance.

Pedagogical approach. In this drill, the instructor acted as an expert, providing information and monitoring student actions. The instructor intervened to provide additional information as required or to give individual feedback to specific students. The students had study material that included treatment algorithms and mastery checklists for these procedures.

The partner and bystander also monitored the attendant's performance and provided correction or feedback.

Fidelity. The pedagogical point of this scenario was to practice a procedure in a specific, but very limited context. The physiological fidelity of the drill was low: the patient was a student with no moulage (make up) who was quite obviously not injured. Similarly, the environmental context was low: the call was staged in a classroom. The information on the presentation of the patient and physical surroundings were provided as verbal information from the instructor. Note that this information was sparse and tightly focused on the presentation of the bleeding. The instructor did not provide any information on the setting or environment, nor any history to the call. The only information given included pallor and the character of the bleeding.

However, the procedural fidelity of the drill was quite high: the attendant wore gloves, followed the standard assessment model, sat the patient down (although pretending that the chair was a stretcher), and used dressings from the jump kit. Note that, in this drill, the attendant acted independently and the driver had an extremely limited role. As the scenario progressed past the initial transcript segment, the attendant continued to perform most of the actions in the call. The driver was asked to take on several tasks, but the majority of the interaction in this simulation was limited to the attendant and the patient. Thus, the scenario provided focused information to the learners and allowed authentic practice of the required procedure.

Case: Classic Case Simulation

The Classic Case simulations are staged near the end of the PCP program. In Classic Case 253, the students perform a series of simulations which focus on application of previously learned skills and knowledge. Where the Core Skills simulations occurred within a lesson on a specific condition (and hence the students knew in advance the patient problem and desired

outcome of the scenario), the Classic Case simulations are mixed presentations of all the conditions the students have studied to date. In addition, the scenarios are designed to allow the students to practice dealing with variations in the treatment algorithms—the patient's condition will improve, deteriorate, or remain the same based on the treatment decisions the students make. Thus, the students are faced with two problems: determining the patient problem (determining the provisional diagnosis) and adapting skills and procedures to use in more varied situations.

Transcript of a Classic Case Simulation

The following transcript describes a segment from a Classic Case 253 simulation, (07_vcr1_253), involving an unconscious overdose patient.

Sample transcript 07_vcr1_253:

PCP1: Student playing the role of attendant
PCP2: Student playing the role of driver/partner
Patient: Student playing the role of the patient
Instructor: PCP instructor who is circulating between groups of students, providing coaching and feedback as required

The video clip opens with a wide shot of an open space in the JIBC's public space—the "atrium." Two female students (PCP 1 and PCP 2) are standing beside a stretcher. They start to lift equipment off of the stretcher and turn towards a small set of stairs. The stairs lead to a sitting area (see Figure 8).

Figure 8. Classic Case simulation staged in a public location on campus.

PCP 1: Leave the NS[10] up here.
<PCP 1 walks around corner and sees male patient sitting slumped on padded bench. She walks down the stairs and approaches the patient.>
PCP 1: Hi, sir, can you hear me? Hello, hello?
<PCP 1 walks beside patient, who is sitting on bench.>
PCP 1: Uh . . . did anyone around you see what happened?
<Patient opens eyes, shakes head.>
Patient: No.
PCP 1: No? <PCP 1 puts equipment down near patient.>
PCP 1: Okay. So . . . Can you hear me? Hello? Hello?
PCP 1: So he's not alert. I'm ruling out D spine because of the way he's lying here. I'm just going to look in your airway. <Places left hand near jaw and opens patient's mouth.> Airway is clear. Could you just—
Patient: Not clear.
PCP 1: It's not clear. <Turns to face PCP 2.> Can you just get me the out the suction, please.
<PCP 1 looks around, moves some equipment out of the way. PCP 2 opens jump kit and takes out suction unit—a handheld device for suctioning fluids from a patient's airway.>
PCP 1: And. . . . thanks. <PCP 2 hands suction unit to PCP 1.>
PCP 1: <Holds suction unit near patient's head, but does not actually insert suction tube in patient's mouth; squeezes suction unit multiple times; looks at patient.> Now is it clear?
Patient: Yeah.
PCP 1: 'Kay.
PCP 1: Let's get him down on the ground. <Hands suction unit back to partner, who puts it in the jump kit.>
PCP 1: <Moves to patient's right side. PCP 2 to patient's left side. Each lifts an arm, but the patient slumps.> . . . You just watch his head. <They lift him to a sitting position.> Here, I'll grab behind him, if you can just kind of help his legs down. <PCP 1 moves behind patient and puts her hands under patient's arms. PCP 2 moves to patient's legs.>
PCP 2: 'Kay.
<Together they move patient onto floor beside bench.>
PCP 1: Uhhhh, let's put him 3/4 prone. <Places patient supine. PCP 2 moves out of camera. PCP 1 lifts patient's left arm above his head. PCP 2 comes back into shot and supports patient's leg and shoulders as PCP 1 moves behind patient and rolls towards PCP 2.>
PCP 1: Can you, uh, measure and see if he'll take an OPA[11]? <PCP 1 moves patient's head onto his arm and points patient's chin towards floor.>
PCP 2: Okay. <Moves out of camera.>
PCP 1: Thanks. <Kneels behind patient.>

Pedagogic intent. This simulation took place in the Classic Case 253 (CC 253) course.

At this point in the PCP program, students have studied the pathophysiology, assessment, and

[10] NS: Normal saline, an intravenous solution.
[11] OPA: Oropharyngeal airway. Curved plastic tube that is placed in an unconscious patient's mouth to ensure a clear air passage.

management of all their classic cases. In prior lessons, they have used skill stations to learn new procedures, drills to incorporate those procedures into overall performance of a call, and full-call simulations to practice integration of their learning. CC 253 consists of several days of mixed simulations. The students work in groups of three or four and complete six or eight simulations each day. They take turns in the roles of patient, attendant, driver, and (when there is a fourth member) first responder. The simulations are straight-forward presentations of common types of calls that the students have recently studied. The learning objective for CC 253 is to "develop and defend a focused assessment and demonstrate the management of classic trauma and medical calls using PCP treatments and protocols" (JIBC, 2005, p. 293). In earlier Classic Case courses, the students practice calls within the context of a particular topic. Thus, during the Cardiac Emergencies lesson, the students enter the practice simulations knowing what underlying condition they will encounter. In CC 253, the calls are mixed—students know the range of calls they will encounter, but not which call they will engage in next. Thus, assessment and clinical decision making are brought to the forefront.

In the Classic Case simulations in this study, the instructional focus on decision making and integration requires environments that contain substantially more information, increased complexity in potential outcome, and a greater range of equipment and physical settings. In addition, as various procedures have been learned and internalized, the participants are allowed to take on more autonomy within the scenarios. Note, however, that the richer information tended to remain as verbal cues provided by instructors and patients.

Structure. The students met for the morning in a plenary room where the instructor went over the expectations for the day and broke the students into workgroups. Each team was assigned a breakout room that served as a staging area and a mock ambulance. The simulations

were staged either in these breakout classrooms or in locations around the JIBC campus. As in the Core Skills drills, the students took turns in each of the roles as attendant, driver, patient, and bystander. Multiple groups of students ran the same simulation from a common script. The situations were much richer than the Core Skills calls. The scenario scripts contained noticeably more background information, richer patient histories, and alternate sets of vital signs that could be given depending on the treatment choices of the attendant. The instructors also increased the environmental fidelity of the calls by staging them in various locations throughout the campus. Thus, learners had to travel to the scene, package the patient, return to their ambulance, and simulate transport. They also had to deal with situational factors such as stairs and elevators and working in public locations.

The instructor prepared all the patients (students role playing the part of a patient) for an upcoming simulation by calling them into the plenary room, giving them a copy of the simulation script, and discussing the expectations and flow to the call. Classic Case simulation scripts typically run three or four pages. The scripts include a list of the objectives or goals for the scenario, a one paragraph description of the physical setting and dispatch information, and a narrative description of the scene including any comments that bystanders, family, or other responders would give the crew on arrival. The following pages provide detailed lists of signs and symptoms, desired actions, and alternate sets of information based on the actions of the attendant. The instructor went over the call with the patients and provided prompts and further information as required.

Pedagogic approach. The focus in the Classic Case simulations was integration of procedures with decision making. The overall flow of the call was outlined in algorithmic form through Principle of Management job aids or protocols. The algorithms used specific findings to

indicate or contraindicate the use of specific protocols and to move between paths in the procedures. The patient and, in some groups, fourth student, provided peer feedback at the end of the call. The instructor circulated between the groups, providing in-call feedback and direction as necessary and looking for overall trends in performance. The instructor provided formal feedback at the end of the call and in a daily debriefing session at the end of the day.

Fidelity. Several aspects of fidelity changed between the Core Skills and Classic Case simulations. The environmental fidelity was variable. The Classic Case simulations were generally conducted either in breakout rooms or staged in locations around the campus. When the calls occurred in the breakout rooms, either the call manager or the patient provided verbal descriptions of the scene and relevant physical findings. The simulation in the transcript above was set in a student study area in the atrium of the JIBC. The simulation script situated the call in an alleyway, thus the campus locations did not always match the scenario requirements. Actions of bystanders and first responders were given as verbal information by either the call manager or the patient.

The overall physiological fidelity of the simulations remained generally low, with students still playing the role of the patients. Most signs and symptoms were given as verbal information. In some cases, mannequins were used for unconscious or collapse patients, allowing for high physiological and procedural fidelity. In the transcript above, note that a student was role playing an unconscious patient. As the attendant performed and verbalized her assessment actions and findings, the patient interjected and provided verbal descriptions of what the attendant should be finding (e.g., when PCP 1 checks the patient's breathing and states that his airway is clear, the patient interrupts to say: "Not clear").

The procedural fidelity remained high with the use of task trainers (e.g., IV arms

alongside the actor) and mannequins for specific types of calls (cardiac arrest and collapse). When necessary in Classic Case simulations (e.g., the simulations are staged without task trainers or mannequins), invasive procedures and drug administration are verbalized or mimed. Later in this simulation, the attendant mimed starting an IV on the actor (placed the catheter alongside his arm, then taped it in place), while the partner mimed giving oral glucose to the patient by going through the motions of placing gel on a tongue depressor, but not placing the gel in the patient's mouth (see Figure 8). However, the majority of procedural activities in a Classic Case simulation are performed in a realistic manner.

The role fidelity of the simulations evolved over the four months that separated Core Skills and Classic Case. The attendant was still in charge of the call and was expected to make the patient care decisions. However, the driver was more active and even initiated many functions. In many of the Classic Case calls, the driver entered the scene and immediately prepared the oxygen in anticipation of the attendant's instructions. The attendant still asked for specific actions, such as putting on the pulse oximeter, but now gave direction for larger chunks of the call. Note, though, that the roles were still constrained. The partner was still restricted from offering advice or overtly redirecting the attendant, particularly on patient care decisions. The structure and the flow of the simulation focused on evaluation of the attendant, not on the crew as a whole.

Case: High Fidelity Simulations

The HF simulations in this study were designed to highlight several aspects of fidelity. The resulted is a practice environment that, while sharing many characteristics with the Core Skills and Classic Case simulations, allows for richer, more dynamic interactions between participants and their environment. The HF simulations are structured and run significantly

differently than the Core Skills and Classic Case calls. While similarities remain, several features of the environment must be enhanced to meet the pedagogical intent of the HFS calls.

The following excerpt is from an HF simulation involving a pedestrian struck by a vehicle staged in the parking lot of the JIBC's New Westminster campus.

Transcript of a HFS

The following excerpt is from a transcript of a Vancouver HF simulation: vcr1_HFS_05. The transcript describes three segments of the call.

Set Up:

CM: Instructor in the role of Call Manager, who sets the physical scene, prepares the actors and participants, and manages the logistical requirements of the scenario
PO 1, 2, 3: Police officer recruits playing the roles of police officers at the scene
Bystanders: Volunteers playing the role of witnesses to the accident and bystanders at the rescue scene
Patient: Volunteer in the role of the patient

The video opens with a wide angle shot of four police officers and four civilians standing in a parking lot. A woman in the middle of the shot is an instructor who is the call manager (CM) for this scenario. She is looking at the four police officers (see Figure 9).

Figure 9. Instructor preparing scenario involving police officers and bystanders.

CM: And then we have the lookie-loos—and oops—we're hoping to have a rear-ender. Again, something else for you guys to step into. And they're now—they as well are going to have to deal with . . . "oh, oh." So you'll have two incidents to look after. In one there's some really angry people, and then you're going to have . . . "We gotta get things worked out for that one as well."
<The police officers turn to each other and begin discussing amongst themselves. The CM turns

to the other participants who will take roles as bystanders at the call.>
CM: Ok, good—see! They're establishing their roles.
Bystander 1: Laughs.
<PO talking, inaudible.>
CM: And so, you three, . . . You'll be like—Mark will be: "Oh, my god!" but he can answer questions. You're trying to console him.
Bystander 3: [Inaudible.]
All: <Laughing.>

The shot moves to a point of view approximately 30 meters back from the previous scene. A female patient lies on her right side on a blanket on the middle of the road. A police officer stands on one side of the patient. An instructor is standing behind the patient holding a bottle. The instructor squeezes the bottle to squirt fake blood onto the patient's arm and create a pool of blood on the ground. In the background, the participants from the previous discussion can be seen talking to each other and going over their roles (see Figure 10).

Figure 10. Instructor spreading fake blood at scene of "pedestrian struck" accident.

Excerpt from transcript vcr1_HFS_05:

PO 1, 2, 3: Police officer recruits playing the roles of police officers at the scene
Bystanders: Volunteers playing the role of witnesses to the accident and bystanders at the rescue scene
Patient: Volunteer in the role of the patient
PCP1: Student in the role of attendant
PCP2: Student in the role of driver/partner
P: Field paramedic in the role of preceptor

The shot opens with three paramedics walking with a stretcher. A variety of equipment is strapped to the stretcher including the jump kit, oxygen, backboard, splint, and a hard collar kit. The crew walks calmly towards a female patient lying on the roadway ahead. As they near the patient they pass by three police officers and a civilian (see Figure 11).

Figure 11. Paramedic crew approaching HF simulation scene involving multiple participants.

Bystander: Yeah, he went that way—he turned right out. I tried to get his license plate . . .
PCP 1: Okay, so . . .
<P moves back and waves PCP 1 to go to patient. P takes over pushing stretcher. Crew moves by police without stopping and goes straight towards the patient.>
P: You go up and check it out. I got the stretcher.
PCP 1: I'll go straight to the patient.
PCP 1: Do I talk to anybody? We can go? It's clear for us to go? <PCP 1 looks at police as he walks by, looks over at his partner. She looks back towards P, who is talking on portable radio.>
P: Code 5[12] . . .
PCP 1: Is it clear for us to enter?
PCP 1: It probably is. <PCP 1 walks around and leans over patient. P and PCP 2 stop stretcher about 3 meters from the patient.>
PCP 1: Hello. Hello. Can you hear me? Megan, can we get some sandbags next to her head just to prevent her from moving. <PCP 1 kneels in front of patient, then looks up at partner. P moves to head of patient. PCP 2 moves to take equipment from stretcher.>
PCP 2: Yeah.
PCP 1: Ma'am, can you hear me?
PCP 1: Unconscious. <PCP 1 puts hand on patient's should and leans over to get close to patient's face. PCP 2 brings sandbags and places them beside patient's head. P stands back, then puts on gloves.>
PCP 1: No fluid in your mouth. Can you get me an OPA—measure and insert it, please, then put some oxygen on her.
<PCP 1 checks breathing, then looks up at partner. PCP 2 moves to stretcher and grabs jump kit. P moves back towards stretcher, putting his gloves on.>
PCP 2: Yup.
P: I'll get the stuff off the cot here.
PCP 1: Can you stop this bleed, maybe, before that.
PO 1: Do you guys need any assistance at all? <PCP 2 places jump kit beside patient's head,

[12] Code 5: ambulance code for referring to police.

kneels down, and opens a side pocket. P moves to stretcher and reaches for some equipment. PO 1 moves into scene near patient's feet.>
PCP 1: Yeah, you can uh, can I get you to put some pressure on—get some gloves on and . . . get some pressure on this . . . <PCP 1 places right hand on patient's right knee where blood is. Brings his hands back up to the patient's side. PO1 moves to jump kit and reaches for gloves.>
PO1: Do you have some more gloves, guys?
PO2: Do you have any idea? Did she turn around or anything like that?
Bystander: Uh, no. . . . I . . . <P places clamshell[13] beside patient, reaches in pocket for gloves, sees that PO 1 has gloves from jump kit, then stands up and looks at PCP 1. PCP 2 reaching into jump kit. PO 3 comes into scene near patient's feet.>
P: Okay, what are we doing here?
PCP 1: We're just, uh, stopping the obvious bleeds.
P: Okay. <PCP1 looks up at P; reaches into pants pocket and hands gloves to PO1. P turns back to stretcher.>
PCP 1: Can you kind of . . . expose the pants?
PO3: You guys need anything?
P: Uh. <P takes towel from stretcher and moves to patient's feet. PCP 1 leans over patient. PO1 puts on gloves.>
PCP 1: Can you cut the pants and . . . just expose . . .
P: yeah, can you get that stuff off of that cot there.
PO3: Yeah. <PCP 1 looking at patient while he talks. P points at stretcher.>
PCP 1: Can you cut off those pants—get that exposed?
P: Yeah, sure.
PCP 1: Get that exposed so we can see what's going on over there?
PCP 1: Okay . . . OPA inserted. <PCP points at patient's legs, then looks back at PCP 2. Leans over and mimes putting in OPA. P uses scissors to start cutting patient's pant leg, then tears material.>
PCP 1: All right. Can I get you to put some pressure on this bleed please?
PCP 1: Or . . . <PCP 1 looks back at injury, then up to PO1.>
P: [Inaudible.]
PCP 1: Can you come over here, please, yeah, and put some pressure, stabilize here.
PO3: Where do you want me to go? <PCP 1 places hands at patient's hips, directs PO1's hands.>
PCP 1: Just push it.
P: Not too hard.
PCP 1: Yeah, not too hard. . . .Your other hand, stabilize the leg.
PO3: Okay. <PCP 1 moves back and leans over to check patient's breathing.>
P: Do you know what happened?

Pedagogic intent. The HFS calls were designed to help learners transition from the classroom to the field setting, as well as foster the development of clinical judgment by creating situations in which the crews would interact in richer personal, environmental, social, and

[13] Robertson Orthopedic Clamshell (ROS): Plastic or metal lifting device that splits into two halves. The segments are placed on either side of a patient, then reconnected.

cultural settings. These simulations placed learners in roles, environments, and situations that more closely resembled the noise, complexity, and interconnectedness of practice in the field. Whereas existing classroom simulations were built around specific learning objectives and outcomes, the HF simulations had open-ended structures. The participants were given general direction and the situation was allowed to play out. Note that the preceptors, unlike instructors in classroom simulations, did not know what the underlying dilemma was in the HF simulations. The preceptors had to participate in the call, develop their own understanding of the situation, and then determine what to focus on in their interactions with the students.

Structure. The students and faculty initially met in a plenary room that served as a home base for the day. A mock triage desk was set up and each crew had a staging area for their equipment that also served as a mock ambulance. The simulations were staged at various locations around the campus, representing public, residential, and commercial locations. In addition, several calls occurred in a community centre swimming pool. The calls ranged from 10 minutes to over an hour. Volunteer actors of varying ages, genders, and ethnicities played the roles of patients. A HF mannequin was used for several calls involving cardiac arrest and unconsciousness. Students participated as the attendants and drivers for the crew. A field paramedic took on the role of the preceptor. Volunteers, police recruits, and fire recruits played family, bystanders, and first responders.

Pedagogic approach. The role of the preceptor in the HF simulations was significantly different than that of an instructor in classroom-based simulations. While instructors controlled both the simulation and provided feedback, preceptors functioned as participants, coaches, and mentors. The preceptors generally stayed in the background of the calls, letting the students take the lead roles. They guided and coached the learners as required, and intervened when necessary

to ensure crew and/or patient safety. Unlike classroom simulations where instructors observe and provide post-call feedback, preceptors actively engaged with the students throughout the call. They prompted, provided guidance, made suggestions, and occasionally took over to perform segments of the calls. The preceptors also provided impromptu debriefings of the calls in the downtimes between simulations, but the format and flow of discussion was much less structured than that of classroom simulation instructors. The preceptors provided both ongoing and post-call commentary, engaged in discussions with the students, and gave focused feedback on specific issues. Their approach tended to be interactive, more participatory, and more collaborative.

Fidelity. The environmental fidelity of the HF simulations was very high. The transcript above involved an incident where a pedestrian had been struck by a vehicle. The call was staged at an intersection in the parking lot of the JIBC.

The Core Skills and Classic Case simulations were tightly scripted with clearly stated goals and expectations. By contrast, the HFS calls were designed as role plays in which participants were given a situation and general guidelines and were expected to act based on the natural unfolding of the situation. A call manager assigned to each simulation set up the physical scene and props, gave directions to the players, and then stage managed the situation as necessary. The directions were deliberately vague. For example, in the transcript above, the call manager provided general directions to the police officers but did not give them scripted lines to follow. She prepared the three bystanders by stating: “And so, you three, ... You’ll be like—Mark will be: ‘Oh, my god!’ but he can answer questions. You’re trying to console him.” After the call manager gave her instructions, the participants had a brief discussion to set up an overall plan for their role play. However, the actual unfolding of events occurred in an unscripted

manner. In this call, the arriving paramedic crew never spoke to the police officers, even though the call was written with the assumption that the crew would stop and obtain information from these participants.

The HF simulations increased the fidelity of several other aspects of the environment. While fellow students were used as patients in the Core Skills and Classic Case simulations, the actors in the HFS calls were recruited to represent more accurately the background of the patients as scripted. An actor with a history of asthma played the patient for simulations involving an asthma attack and an episode of congestive heart failure. An elderly volunteer with an extensive cardiac history played a cardiac patient for several calls. Similarly, the role and interpersonal fidelity of the simulations was increased by having fire and police recruits as well as life guards play first responders. Volunteers from JIBC staff, family, and friends took on roles as family and bystanders. The paramedic crews were explicitly asked to function in a more natural manner. The driver was encouraged to anticipate and interject, to function as a full member of the crew. The preceptors were asked to function as they would in a practicum setting. They were asked to participate, coach, question, and even intervene to take over a call if required. The result was a rich, interactive environment.

Discussion: Blends of Form and Function

Simulation and fidelity are often used in the literature as singular terms. Yet, in this study, I found that the differing pedagogic goals in each course led to the development of simulations with substantially different structures and blends of fidelity (see Table B1, Appendix B). The Core Skills lesson focused on *mastery* of relatively context-free skills and procedures. Thus, the instructor staged the drills in a single room to create identical learning opportunities in which learners could develop and demonstrate consistent performance. Mastery checklists provided

detailed criteria for performance. While the overall fidelity of the simulation was low (particularly the environmental, physiological, and role aspects), the key features of the conditions being practiced were highlighted. And, surprisingly, the procedural fidelity was very high. Thus, the drill was effectively structured to meet its goals.

Similarly, the Classic Case simulations had fairly low physiological and environmental fidelity. Patient data were provided primarily as verbal information, given from the simulation script by either the patient or the instructor. The calls were staged in separate rooms, ran longer, and focused on integration of procedures within a complete call. The role fidelity was still limited, but both attendant and driver functioned more autonomously, particularly when performing previously learned procedures. These calls also provided prototypical experiences for the learners, and thus the patient information was richer and more complex. Learners practiced acquiring specific types of information (e.g., signs and symptoms) relevant to the particular case, even though the verbal means by which they obtained that information was artificial. Again, however, while the information may have been provided verbally, the patient data were designed to give clear and unambiguous examples of the various conditions.

The HF simulations, in contrast, specifically increased the environmental, role, and interpersonal aspects of fidelity. This was in keeping with the goal of creating a rich environment for the learners to engage in the non-patient care aspects of performing an ambulance call. Thus, the patient presentations were more ambiguous and less critical to the pedagogic intent of the calls. In fact, several of the scenarios were designed so that the learners could choose one of several treatment options. In these calls, the pedagogic intent was to situate clinical reasoning within a broader context, not to practice its pieces. Similarly, the calls in the HFS module ranged from innocuous situations requiring no treatment to acute multiple trauma and cardiac arrest. In

contrast, however, to both the Core Skills and Classic Case calls, the majority of simulations in the HFS day did not require advanced or invasive procedures. Again, this was more in line with practice in the field. Intriguingly, increasing the overall authenticity of the simulations by choosing calls with a range of acuity and emphasizing the social and environmental aspects of the environment decreased the requirements for physiologic and procedural fidelity.

The Move to Interpretation

Having described three learning environments encountered in this study, I return, in the next chapter, to the questions that guided the study and provide a preliminary set of findings.

As outlined in Chapter 3, I employed mixed methods in an iterative process of analysis, data gathering, and articulation. I started by analyzing the main research question through the perspective of learning as a complex, open system. Following a postmodern, poststructural approach, I chose to focus on the interactions and relationships between the participants and the simulation environment in relation to several key concepts in this study: the processes of patient assessment (including clinical reasoning), clinical judgment, teaching, and learning. I derived a series of subquestions, then further analyzed these subquestions to develop a series of bounding questions through which to collect and interpret data.

The development of the subquestions and methods for their exploration was a reflexive process in which the results of one phase of analysis prompted modification or new questions for further exploration. The result was an initial set of descriptive data, narratives, coding frameworks and tables, collections of analytically linked video clips, and journal notes, which were organized in the context of the subquestions of the study.

Table B2 (see Appendix B) lists the initial statement of findings that emerged from data gathering and analysis. My initial analysis of these findings involved categorizing the statements

in relationship to the central question of the study: identifying factors that positively or negatively influence the development of clinical judgment. At the same time, I identified for further study specific findings that were either interesting or puzzling. The results of this initial review produced a list of prioritized findings from which to begin further analysis and meaning-making.

This list was, in itself, interesting and useful. But the findings, as isolated findings, were also limited and limiting. For example, one finding was that, six months after the HF simulations, the participants found that the increased fidelity of the simulations had helped their learning. While interesting, this statement added little to understanding the relationship between fidelity and learning. And its implications (that increasing fidelity leads to improved learning) stood in contrast to another finding that procedural fidelity was high across all types of simulation activities. Similarly, the initial statement (increasing fidelity leads to improved learning) appeared contradictory when compared to the finding that participants effectively used mimicking, mirroring, and miming to simulate activities which could not be easily performed in the simulation environment in a way that caused minimal disruption to the flow of the experience. In effect, mimicking and miming *reduced* the fidelity of certain activities in a way that *improved* the learning experience. Together, these statements evoked one of the dilemmas identified in Chapter 1: the under-theorized relationship between fidelity and learning.

Other findings appeared to be almost tautological when considered in isolation, such as the statement that "preceptor comments frequently speak to adaptation and contextual performance." This was to be expected. The role of the preceptors was explicitly set as helping learners adapt what they have learned to the field setting. Yet, this finding took on an entirely different connotation when paired with the finding that "advice given by each practitioner differs

from the others, each situated within the context of the overall conversation and the calls in which the advice is being given," particularly when considered with the finding that there was "no consistent pattern [in the topic or type of feedback given by preceptors] even on calls with similar problems." Together, these findings did not affirm the role and actions of the preceptor in helping learners transition from the classroom to the field. Rather, these statements highlighted the unchallenged assumption that the classroom and the practicum are simply progressive stages in the development of competent practice. This implied that the uncertainty that graduates experience as they enter field practice consists of more than the randomness of call distribution in a given jurisdiction. There is uncertainty, also, in the expectations and meaning that different (competent and practicing) practitioners create within the calls that they are performing.

Development of Conceptual Categories

The initial findings in Table B2, then, served as a starting point for analysis, interpretation, and representation of this study. Meaning emerges in a hermeneutic process (Gadamer, 1975; Kincheloe & Berry, 2004; Merriam, 1988) of iteratively considering findings and analysis in relationship to the central research question, the goal of the research, and the dilemmas and practical problem posed in the study. As I worked with the data in this study, I noticed the emergence of trends and cross-cutting themes that quickly organized around several conceptual categories related to the use of simulation in teaching and learning. Thus, in the previous examples, a series of data statements and findings emerged related to how simulation environments are structured to meet specific types of learning goals, each calling upon differing blends of fidelity within their elements. The statements in the second example organized around a critical analysis of what forms of authority instructors and preceptors use to create meaning, make decisions, and provide assessment and direction to their learners.

A series of 32 general themes emerged from the initial findings (see Table 4). These, in turn, organized around five conceptual categories that served as the primary organizing paradigm for presenting and discussing my analysis and interpretation of the findings (see Chapter 6).

Chapter Summary

This chapter provided three cases—examples of distinctly different yet deeply similar learning environments. These cases represented several distinct types of practice learning situations, each of which called for differing blends of structure, pedagogic activity, and fidelity to support particular learning goals. The relationships between the learning goals, structures of the simulation environment, and aspects of fidelity were neither simple nor direct.

In Chapter 5, I move from presenting descriptive characteristics towards exploration of the relationships and interactions of the participants with these simulation environments.

Table 4. Emergent themes and conceptual categories

General Themes	Conceptual Categories	Cross-cutting Themes
Matching strategy and outcome	How do simulations foster teaching and learning?	Fostering CJ
Role of simulation	How do simulations foster teaching and learning?	Fidelity
Making pedagogical points	How do simulations foster teaching and learning?	Fidelity
Progression of learning	How do simulations foster teaching and learning?	Progression of Learning
Need for coaching	How do simulations foster teaching and learning?	Fostering CJ
Instructors & Preceptors—participation levels	How do simulations foster teaching and learning?	Different Ways of Knowing
Instructors & Preceptors—different roles	How do simulations foster teaching and learning?	Different Ways of Knowing
Instructors & Preceptors—situated feedback	How do simulations foster teaching and learning?	Different Ways of Knowing
The dance	How do participants interact in sim?	Progression of Learning
Tend to stay in tech	How do participants interact in sim?	Different Ways of Knowing
Popping	How do participants interact in sim?	Mental Constructs
Reduced interaction w/ the HFS environment	How do participants interact in sim?	Discernment
Immersion	How do participants interact in sim?	Discernment
Discernment	How do participants interact in sim?	Discernment
How to function in new environment	How do participants engage with sims?	Fidelity
Horizons	How do participants engage with sims?	Discernment
Unengaged (decreased role fidelity)	How do participants engage with sims?	Fidelity
Primacy of verbal information	How do participants engage with sims?	Mental Constructs
Function and structure of information	How do participants engage with sims?	Progression of Learning
Primacy of PAM	How do participants engage with sims?	Mental Constructs
Mental constructions	How do participants engage with sims?	Mental Constructs
Big and little decisions	How do participants make decisions in sim?	Different Ways of Knowing
Use of clinical reasoning	How do participants make decisions in sim?	Discernment
Tunnel vision	How do participants make decisions in sim?	Discernment
NAR and AR—even as novice	How do participants make decisions in sim?	Discernment
Changing role of participants	How do participants interact in sim?	Fidelity
Different ways of knowing	What is right and true in sim?	Different Ways of Knowing
Constructed right and wrong	What is right and true in sim?	Different Ways of Knowing
Fidelity—flaws in the matrix	What is right and true in sim?	Fidelity
Sims as constructed experiences	What is right and true in sim?	Fidelity
Sims as real experiences	What is right and true in sim?	Mental Constructs
Calls as simulation experiences	What is right and true in sim?	Fidelity

CHAPTER 5: TEACHING AND LEARNING IN SIMULATION ENVIRONMENTS

As outlined in the previous chapter, my initial list of findings and statements were linked by my research question and subquestions and initial conceptions as well as an emergent and experiential trail. In this chapter, I move from description and analysis to an inductive process of interpretation. The conceptual categories that structure this chapter represent an abstraction and juxtaposition of multiple forms of evidence and perspectives, particularly in relationship to the broader concepts or goals of this study (Creswell, 2012; Eisenhart & Jurow, 2011). The conceptual categories are presented as statements about how simulation is related to decision making, learning, teaching, and their underlying epistemological and ontological assumptions. These conceptual categories formed a framework from which to discuss the findings and articulate the relationships among concepts that moved over and through the findings (Creswell, 2012).

There are five conceptual categories that form the basis of this chapter's discussion and exploration:

1. How do participants teach and learn using simulation?
2. How do participants interact and function in simulation environments?
3. How do participants think when in a simulation?
4. How do participants make decisions?
5. What is real and true in simulation?

Each of these areas of discussion speaks directly to how simulation may be used to develop competence, move towards expertise, and foster clinical judgment in paramedic learners.

How Do Participants Teach and Learn in Simulation?

Curriculum concepts and tools, such as the JIBC's Practice Ladder, imply a simple-to-complex progression of learning as learners engage with increasing rich instructional structures and activities. However, the simulations in this study displayed an intriguing mix of pedagogic elements and activities. As shown in Chapter 4, different blends of structure, fidelity, and

pedagogical practice emerged within each type of learning environment in this study.

The first category in this chapter explores conceptions of teaching and learning in simulation through an analysis of the roles that preceptors and instructors take and the ways in which they engage with learners in different types of practice learning settings. I describe and categorize instructors' and preceptors' feedback, then develop a series of thematic forms through which to explore the structure, strategies, topics, and intent of their feedback in relationship to their respective learning goals. Together, this exploration provides rich descriptions of the varied forms and interactions involved in teaching and learning in simulation environments.

Role of the Instructor and Preceptor

Teaching and learning are related processes, but, as with learning outcomes and fidelity, the links and relationships between these processes are not always clear. This study presents evidence that learning is not necessarily a linear progression, nor is it the accretion of discrete building blocks of skill and knowledge. Within this study, learning is framed as an organic process with the integration of procedures requiring more than simple addition of steps to a process. Similarly, teaching—and in particular, providing feedback and correction to learners—seems to be a situational process in which multiple strategies and levels of detail and abstraction are employed by instructors and preceptors to achieve desired results. In this section, I briefly describe the role of the instructors in the Core Skills and Classic Case calls, then focus on the interactions of the preceptors within the HF simulations.

Role of the instructor in classroom simulations. Core Skills simulations in this study took the form of short drills and uncomplicated simulations that focused on the development of specific skills and procedures. The Core Skills simulation described in Chapter 4 involved a patient with epistaxis (nosebleed), who was leaning against the sink in a bathroom. The scenario

was staged as a drill, with students broken into six groups and distributed around a large classroom. The instructor set up the scenario by directing the patients to stand, leaning over chairs. He called out the scenario setup information to all groups at once. The instructor provided a verbal description of the scene, then directed the students to start the call. The instructor moved between groups, stopping to give advice or correction as necessary.

The first few minutes of the scenario were hectic—this is the Primary Survey where the paramedic performs a prioritized assessment to locate and deal with immediately life- and limb-threatening situations. The instructor watched all of the groups, ensuring that the steps in the Primary Survey were properly performed and that the interventions required for this case were dealt with. The instructor continued to circulate, but, as the attendants moved into the Secondary Survey (a more comprehensive assessment of the patient) the pace of the call slowed, the discussions between instructor and students moved from short directives on specific activities ("get him sitting down right away—he's been bleeding for a while") to short conversations that included rationale or discussion (PCP: "Should we just put him on the stretcher?" Instructor: "If it's close by and you can get him onto it, yes. But sometimes you have to just use what's at hand. If you can't get the cot in, sit the patient down on the toilet for now."). At the end of the drill, the instructor provided a quick summary and went over key points from the lesson.

The instructional strategy for this drill supported a specific learning objective of demonstrating the management of bleeding using PCP procedures and equipment (JIBC, 2005). This objective was tightly framed on the procedure itself, with no mention of context. While the instructor provided some contextual advice, his primary concern was that students perform the steps of the procedure correctly and in the appropriate order. A drill strategy allowed the instructor to focus on procedure and consistent performance. The instructor could monitor all

participants, plus the participants could watch and learn from each other. Feedback given to one student was available to all.

The Classic Case simulations focused on learning and integration of assessment and management procedures within the context of complete calls. The simulations were based on a higher order learning outcome asking students to demonstrate the assessment and management of patients with chest pain using PCP procedures and protocols. Students were expected to integrate previously learned procedures (such as hemorrhage control in the example above) with assessment procedures and the application of knowledge such as the signs and symptoms of various conditions causing chest pain, as well as the algorithms that describe their management. The simulations still ran from a common script; however, the instructor now focused on decision making and sequencing of activities rather than on skill performance. The students practiced in separate rooms and provided peer coaching and assessment based on treatment algorithms and simulation scripts.

The instructor-led scaffolding strategies from Core Skills were gradually withdrawn as the students functioned with increased levels of competence and confidence. The instructor's role moved from direct coaching to monitoring and facilitation. The instructor provided the initial set-up to the call, prompted the patients on how to act during the call, and noted potential issues to watch for during the call. The instructor then moved from room to room, monitoring several calls. The instructor noted problems or issues for later discussion. Where the instructor actively intervened in the moment during Core Skills drills and simulations, she now noted trends and issues for discussion at a group level. The instructor still intervened when she saw an obvious problem, but generally tried to remain as unobtrusive as possible.

Several aspects remained constant between the Core Skills and Classic Case simulations.

The simulations in both courses were chosen to make specific pedagogical points and were focused on predetermined outcomes or objectives. The instructor knew before the start of the call what the nature of the problem was, the choices that the crew should make, and what potential issues could/should arise in the simulation. Feedback, while tailored to the students' performance, was both gathered and delivered in a structured manner based on the predetermined objectives of the call. The objectives themselves were structured in a simple-to-complex manner, and the lessons in the program led learners from mastery of the clinical reasoning model (embedded as the patient assessment framework for paramedics) to increasing competence in its use to manage prototypical presentations of common injuries and medical conditions. The learners established a skill and knowledge base from which they progressed towards practice in the field. The instructional strategies and the role of the instructor mirrored the requirements of the objectives, progressing from highly structured intervention early in the program to a gradual withdrawal of support. There was a delightful and elegant symmetry to the match between learning outcome and instructional strategy—a symmetry set in a larger mirroring of the delivery of the curriculum with the classic instructional design process from which it emerged. Both learners and instructors called upon and counted upon the consistency and objectivity of the process. Learners developed technical competence based on the clearly articulated expectations of the curriculum. Those expectations became the objective, external standard towards which the instructors molded the students and by which they assessed the students' technical competence.

Role of the preceptor in HFS. The role of the preceptor in the HFS environment, however, is significantly different than that of the instructor in classroom simulations. A practicum environment allows experiential learning in an apprenticeship setting. Learners perform under the guidance of an experienced practitioner. The preceptor guides and directs the

students, but also ensures that both patient and practicing paramedic remain safe. An additional desirable aspect of the practicum (particularly for this study) is that coaching, reflection, articulation of thought, and feedback are expected activities of the environment.

The HF simulations in this study were designed to explore the learners' ability to incorporate increasingly complex contextual factors into their awareness and decision making. The preceptors, along with the students, had no idea what degree of acuity the call would represent, how many patients there were or who they might be, or what other contextual factors would have to be considered to complete the call. In addition, some of the calls were designed to be deliberately ambiguous—the crew could treat conservatively, aggressively, or even choose not to treat—there were even calls in which there were no patients. Not only did the preceptors not know what the *right answers* to the calls would be, but the calls in and of themselves were not designed to have predetermined *right answers*. The scenarios were staged as dynamic environments in which the participants could engage with each other and explore the practice of their craft. This unpredictability reflected practice in the field and was in stark contrast to the control of the scenarios enjoyed by the classroom instructors.

Roles and activities of the preceptors. The interactions of the instructors and preceptors were distinctly different on several fronts. While the instructors in both Core Skills and Classic Case simulations were external to the scenarios, the preceptors were active participants in the calls, in addition to their instructional role. One of the subquestions of this study asked how participants in the HF simulations interacted with each other. Table 5 lists the codes that emerged to describe the activities of the preceptors in the HFS calls.

Table 5. Preceptor activity codes

Code	Description
Watching	Preceptor is watching, not involved in activity related to the call.
Prompting	Preceptor uses questioning or subtle hints to prompt actions or a line of thought. Prompts suggest an activity but do not explicitly instruct the student to do something specific.
Coaching	Preceptor gives advice and/or correction while student is performing an activity or action. Coaching is related to the activity of the student and involves giving suggestions, providing alternatives, and/or assessing the performance.
Directing	Preceptor instructs students on what to do and/or how to do it. Directing differs from coaching and prompting by having the preceptor make the choice of activity and by its specificity—the preceptor does not suggest options, but informs the student what to do or how to do something.
Intervening	Preceptor takes over the primary role in the call, makes decisions and either performs or directs assessment and treatment activities. Preceptor may intervene to perform a single task or for longer periods of time.
Parallel or additional	Preceptor allows student to run the call, but starts performing assessment or treatment options in parallel. The preceptor sometimes appears to be gathering the same information the student did, but does not want to interrupt or distract the student. At other times, the preceptor is performing similar activities, but in greater depth or detail.
Discussing/collaborating	Preceptor is discussing the call with the student or is acting collaboratively. For example, the preceptor and student may be discussing a provisional diagnosis. Or the preceptor may join the attendant and partner in performing a spinal roll or gathering equipment to prepare for transport.
Acting as directed	Preceptor performs a task as directed by the student or by an ACP member.
Acting independently	Preceptor is performing assessment or treatment activities independently of the student. In this mode, the preceptor is not acting to prompt or mirror the student, nor in parallel to gather similar information, but, rather, is doing something completely unrelated to the student's current activities.

In the HF simulations the preceptors took on three broad roles: observer/evaluator, coach, and participant. In general, the preceptors hung back on calls, observing and not intervening in the progression of the call. At other times, the preceptors became engaged in the call—often preparing equipment or helping to perform two-person tasks (e.g., lowering the stretcher or stabilizing an injured limb). And, on occasion, the preceptors took more control of the scenario, either by prompting or coaching the student or sometimes by literally taking over direction of the call for a period of time.

The following sections explore the three broad roles that emerged from analysis of the instructor and preceptor activities (see Table 6).

Table 6. Preceptor roles

Role	Codes
Observer/Evaluator	Watching Parallel or additional Acting independently
Coach	Prompting Coaching Directing
Participant	Intervening Discussing/collaborating Acting as directed Acting independently

Observing, assessing (the patient), and evaluating (the learners). Both instructors in the classroom simulations and preceptors in the HF simulations spent considerable portions of the scenarios watching and observing. Both instructors and preceptors monitored the students, noting—for future discussion—areas of concern, opportunities for improvement, errors, and tasks well done. However, the preceptors engaged much more actively in the calls. First, the preceptors functioned as part of the crew. Thus, the preceptors often engaged in collaborative activities, such as preparing equipment, helping to perform lifts and transfers, and performing tasks as delegated by the attendant (see Participating, below).

The preceptors, however, also had to assess the scene and patients and determine what was going on. Unlike the classroom instructors—who knew the background and desired outcomes of the calls—the preceptors had to develop an understanding of what was going on in the call so that they could ensure that the students were functioning safely and appropriately, that the patient was receiving the needed care, and that the preceptor could give meaningful feedback and direction to the students. Thus, the preceptors often performed their own assessment of the patient in parallel to the students' efforts. They gathered data from the students' actions,

occasionally asking the students to verbalize their findings. At other times, the preceptors worked alongside the students, asking follow-up questions or checking something that they thought the student might have missed. On occasion, the preceptors acted independently of the students. For example, while the student might be asking history questions, the preceptor performed a physical assessment activity or asked different questions of the bystanders. In these cases, it seemed as though the preceptor thought that the students had missed something or were going in a different direction with their assessment than the preceptor wanted to go. Often, after such activity, the preceptor either verbally reaffirmed the students' actions or stopped and redirected them.

Coaching. The preceptors engaged in numerous instances of coaching throughout the HFS calls. These interventions ranged from providing subtle hints and probing questions meant to spur the students to a particular course of action, to more direct instruction on what to do or how to perform a particular procedure and, finally, giving feedback and advice on how to perform specific activities.

During a Kelowna HF simulation, the preceptor used a variety of forms of coaching techniques when she perceived that the students were not recognizing the acuity of the patient's condition. The preceptor intervened to prompt and coach the students several times. Her interventions either highlighted important activities and findings or prompted the students to move more quickly through the call.

Description of vcr1_HFS_01:

The attendant approaches the patient and begins asking history questions. The preceptor notices that the patient, who looks pale and is complaining of pain, is left standing while the attendant starts her assessment. The preceptor gives a gentle suggestion: "You might want to sit him down." The attendant nods, then continues her questioning. The preceptor waits a few moments, then moves to the other side of the patient and this time directs the student: "We just need to sit him down."

As the call progresses, the preceptor notes that the partner has taken out the pulse oximeter but seems reluctant to approach the patient and put it on. The preceptor encourages the partner by

nodding and pointing to the patient. Only 90 seconds have elapsed since the crew approached the patient when the preceptor intervenes for the fourth time. This time, she literally draws the attendant's attention away from the patient's history by physically gesturing, asking the student to look at the bigger picture, and note the patient's pallor.

Finally, in this clip, the preceptor once again prompts the partner to engage in the call. The partner has the blood pressure cuff in his hand, but, once more, seems reluctant to interrupt the patient and attendant. The preceptor encourages him to "charge right in" and reminds him that, as the partner in the field, it is his responsibility to take more initiative to get vital signs "immediately."

The students proceeded to work through the call step-by-step, following their patient assessment model, with the partner repeatedly waiting for direction from the attendant. Even though the partner often anticipated the attendant's needs (for example, by preparing the pulse oximeter and blood pressure cuff), he was reluctant to perform those actions independently. The preceptor saw the call differently. She observed an elderly man who was pale and appeared upset and a bit confused, complaining of pain. She interpreted the scene as representing a patient in distress who required immediate intervention and assessment. Her initial interventions were subtle, but became directive when the students did not pick up on her sense of urgency.

Later in this call, the preceptor continued to coach the students. However, by now, she was comfortable that the patient's immediate priorities were taken care of, and she used her coaching techniques to extend the students' assessment activities. She provided prompts and suggestions, trying to focus the students on exploring the patient's condition. The attendant often asked a question, got an answer from the patient, and then moved on to the next question in the assessment model. The preceptor intervened several times to suggest follow-up questions. She did this in two formats. Sometimes she prompted by providing specific questions ("Has the pain scale changed?"), which the attendant then repeated to the patient directly; other times, the preceptor prompted the student along a new line of questioning by asking if the student had considered some aspect ("So, did you ask the patient if he's had any trauma recently?").

The third style of coaching involved correcting or redirecting students when they were not doing what the preceptor thought should be done or when the preceptor was trying to get students to see things in different ways. In another Kelowna HF simulation (kel_HFS_10), the preceptor's focus was on the process of clinical reasoning, not on the steps. She saw that her student was struggling to obtain and understand the patient's history. She provided a variety of prompts and suggestions. The student worked through the steps in his history-taking model: he noted that there was pain, then asked a series of patterned questions to investigate the pain and associated symptoms. But his questions did little more than give him descriptive data. The preceptor suggested a series of questions that explored the presence of likely medical conditions. She moved away to work with the partner and returned to find that the attendant was still just asking descriptive questions. She finally came out and stated, "You have to start ruling some things out here." What she left unsaid was that the point of the history-taking model is to find out what is wrong with the patient—it is not just a set of questions to ask. She asked the student to list off potential causes of abdominal pain, and then proceeded to check for signs or symptoms that either confirmed or rule out their presence.

Participating. The third type of interaction used by the preceptors was active participation in a call. In both of the previous instructional roles, the preceptor functioned to support the students. The preceptor monitored the call and allowed the students to work their way through the scenario. But sometimes, the preceptor became an active participant—a part of the crew. This participation took several forms: acting as a partner, anticipating and meeting needs in the call, modeling and mentoring, or intervening to ensure smooth functioning of a call.

Acting as a partner. The preceptors functioned as part of the crew in all of the HF simulations. This role was evident whenever the preceptor discussed options or made

suggestions to the students or worked collaboratively on multi-person activities such as patient transfers or gathering equipment. The preceptors also functioned under direction of both the attendant in their crew and the ACP attendants on layered response calls. Often, the attendant in a call asked the driver or preceptor to perform some task, such as getting additional history from bystanders or preparing a piece of equipment.

Anticipating and meeting needs. Several of the preceptors maintained active roles in the calls. One, in particular, tended to stay engaged in the call and used anticipation and action to guide or prompt the students. After their first call together (vcr1_HFS_01), this preceptor told his students:

> Ah if you—the way I present this, is that things appear for a reason. So when you're doing a call and you see a BP [blood pressure] cuff beside you, there's a reason it's there. When you see the—when you see pieces of equipment, I'm trying to cue you that you need to be moving this faster. Your rapid body assessment [on the call just completed] was not rapid.

And throughout the day, he was constantly working ahead of the students, anticipating their next actions, preparing equipment, moving the stretcher into place, or handing things to the students to remind them to complete tasks.

The preceptors also spent considerable time working with the students who were in the role of drivers. In the field, the driver's role includes anticipating and preparing equipment for the attendant. In the classroom setting, this role is constrained to ensure that the driver does not prompt or coach the attendant, who is in charge of the call. Thus, the more active driver role was new to the students. The preceptors coached and prompted the drivers throughout the day on the expectations of this new (to the students) role.

Modeling and mentoring. The preceptors also used modeling and mentoring activities to guide and shape the students' actions. The most common form of this occurred when the preceptors provided questions for the attendants to ask. In several of the calls, the attendants

went through the process of taking a history but did not ask follow-up questions to further explore that patient's responses.

In a Kelowna HF simulation, a preceptor gave the attendant a series of follow-up questions, trying to prompt the student to look for signs or symptoms of various conditions that may be causing the patient's abdominal pain. In a Vancouver HF call, a different preceptor and his students were placing a Roberston orthopaedic stretcher (ROS) on the patient. The students have practiced using the ROS with each other as patients, but they have never used it for a patient who is actually in pain—they do not seem to realize that excess movement will aggravate the patient's injuries. The students start to go through the motions of putting the ROS in place but seem oblivious to the fact that the patient does not understand what they are doing. The patient's anxiety increases as they work. The preceptor intervenes and models the type of interaction he thinks the students should be using, rather than simply giving them feedback.

Excerpt from vcr1_HFS_01:

The patient, Joe, is an elderly man, lying on a hallway floor in his care home. He has a fractured hip. His legs are secured together with elasticized straps. A blanket is visible as padding in-between the legs. The clamshell is split into two pieces, one on the floor on either side of the patient. PCP1 is on the patient's left side. PCP2 and the preceptor are on the patient's right side

Preceptor: <Points to PCP1.> So, if you want to go on that side and slide that in place. Slide it in. <Speaks to the patient, Joe.> We're just going to roll you up a little bit on your side, Joe. That's it. That's it.
<PCP2 and the preceptor hold the patient's shoulders and hips and ease them slightly off the floor. PCP1 slides the clamshell piece underneath the patient. The patient moans as they shift his weight.>
Preceptor: Okay. Just keep on inhaling that nitrous[14]. Does that help? Is that helping with the pain at all?
Patient: Yeah.
PCP1: We should get a pad for his head here. Joe, I'm just going to put this . . . okay.
Preceptor: Was the top [of the ROS] too high up?
PCP1: Yeah, it's too close—it's too close to his head, yeah.
Preceptor: <Moves top part of ROS away from the patient's head. PCP2 places pillow under patient's head.> There you go. How's that?

[14] Nitrous oxide, an inhaled analgesic.

Patient: That's better.
Preceptor: That's good. Okay, now we'll roll him up on his side. Take another couple of deep puffs there, Joe. Okay. Now, we're going to roll him up now. If you can. Okay, that's good.

In this scene, the preceptor is both collaborating as a partner in performing a complex procedure (securing the patient to the ROS) and modeling the type of interaction that the students need to have with the patients while performing that action.

Preceptors often modelled a particular way of interacting with bystanders or patients, or performed a particular way of doing a procedure, as a sort of impromptu in-call demonstration. These activities were seldom announced as learning activities. Rather, the preceptors tended to simply slip into the call and naturally perform the activity. The preceptors perhaps discussed the activity in the call or recalled it during the post-call debrief. However, most of these interactions simply occurred in the moment without further comment.

Intervening. A final form of participating in the calls involved situations where the preceptor took control of the call and functioned as the attendant for a period of time. Intervening differed from mentoring and modeling in both the length and intent of the activity. Modeling and mentoring activities tended to be short, spontaneous activities, embedded in the overall flow of the call. Interventions, however, tended to be more dramatic instances where the preceptor actually took over decision making or performed an important procedure.

What was particularly interesting was when and why the preceptors intervened in calls. While the preceptors generally remained in the background, they intervened in instances where the students were struggling or, in particular, when patient or crew safety might be compromised. In classroom simulations, the instructors allowed the students to make errors and observe the consequences. But in the practicum setting, where the consequences may include aggravating a patient's condition or allowing unsafe actions to occur, the preceptors actively assumed control.

A Vancouver HF simulation (vcr1_HFS_09) was a multiple trauma call involving a pedestrian struck. The patient was unconscious with significant bleeding from several compound (open) fractures. PCP 1 initially approached the patient and began a Primary Survey. He became sidetracked almost immediately. He first asked PCP 2 to stabilize the patient's head, then asked PCP2 to get an OPA to secure the patient's airway. He noticed obvious bleeding from the patient's legs and directed a police officer to put on gloves and help control the bleeding. The preceptor initially stayed in the background and began to take some of the equipment off the stretcher—presumably in preparation for transporting the patient.

The preceptor let the attendant, PCP1, struggle, flitting back and forth between priorities, but not dealing definitively with any of them. The preceptor moved closer to PCP1 and began assisting. As the student continued to struggle, the preceptor gradually assumed control of the call. He asked PCP1 about the airway, whether the patient was breathing, and what her pulse was like (sequencing his questions in the order of the steps of the Primary Survey). PCP1 answered the questions and performed the steps he had missed. Once the preceptor was satisfied that the immediate priorities were under control and that the student was again on track, the preceptor began to fade back, and soon was in the background. In the post-call debrief, the preceptor ensured that he spent time with the student talking about how to manage immediate patient priorities and better manage his resources.

The preceptors also intervened in instances where scene safety was an issue. In a Vancouver HF call (vcr01_HFS_11), the crew responds to a routine "man [*sic*] down." These calls are typically for someone collapsed ("found down") on the street. Often, these are simple calls involving a person who has had too much alcohol or drugs. However, these calls can also involve trauma or patients with serious medical conditions that mimic intoxication. And, on

occasion, the calls can become violent, especially when the patient is overdosed or psychotic.

Description of vcr1_HFS_11

The crew walks with their stretcher towards the scene. In the distance, the crew sees three police officers and three women standing near a man who is lying on the ground. As the crew approaches the scene, the preceptor prompts the students to look at salient features of the scene. He notes that police are already on scene, as are several bystanders. The presence of police may indicate either that the scene is controlled or that there is potential danger. The fact that the police are standing and talking with bystanders while standing next to the patient lowers the chance of immediate problems. By asking the students to look at the person on the ground, the preceptor has prompted them to assess that the patient is awake and moving, and therefore is probably conscious with a clear airway and adequate respirations and pulse (the critical first steps of the Primary Survey). The preceptor does not explain his questions or put meaning onto the answers—rather he simply poses questions, highlighting the features that he thinks are most important at this point.

The crew approaches the patient and sets the stretcher about two meters away. The attendant, PCP1, asks the police officer what happened and kneels down beside the patient. The preceptor has his back to the scene and, as is his custom, has started taking things off the stretcher (preparing it for transport). When the police officer states that the patient has been "swearing at the ladies here" the preceptor turns quickly and starts to approach the scene. The attendant starts talking to the patient:

As the call continues, the patient alternates between being unresponsive and yelling at the attendant. The preceptor initially moves near the patient's feet, and then, as the patient continues to act aggressively, kneels beside the attendant, near the patient's thighs, in a position where the preceptor can see the patient's face and block the patient's legs (if the patient were to start kicking). The preceptor asks the police to stay, which is a prompt to both the students and the police that he is concerned about the patient's behaviour.

The student rolls the patient onto his back and continues the Primary Survey by performing a rapid body survey, a hands-on check of the patient's body for injuries or deformities. The patient starts shifting and squirming. The preceptor again moves—this time standing and going around to the patient's feet where he can see the patient's face. The preceptor places his one foot near the patient's legs, again blocking any potential kicking motion. A bystander comes into the scene and asks if the patient is going to be okay. The police officers turn to talk to the bystander. The preceptor intervenes again to ask if everyone could move back from the scene.

The attendant notices that the patient is not responding again and reaches for the patient's shoulders. The patient startles, then tries to brush the attendant's hands away. This time, the preceptor intervenes in the call. He leans over and gives the patient a sternal rub.[15] He calls out: "Hey, hey, hey—what's your name? Hey. What's your name? What's your name? What's your name?" Over the next 45 seconds, the attendant asks questions to rule out diabetes, checks for

[15] Sternal rub—the preceptor rubs his knuckles over the patient's breast bone as a way of creating a pain response to wake up patients with a decreased level of consciousness.

odour of liquor, asks if the police found any sharps on the patient (syringes, which might indicate narcotic or other drug overdose). The preceptor stays close to the patient, repetitively asks the same questions, and determines that the patient has been drinking and taking some unknown pills. The preceptor stays engaged with the patient while the students take a blood pressure and other vital signs. Once the students have the information they need, the preceptor lets the patient go back to sleep and once again fades to the background of the call. However, the preceptor continues to reposition himself to maintain visual contact with the patient while he prepares the stretcher.

In a Kelowna HF simulation (kel_HFS_09), another crew responds to a domestic dispute at a residential trailer park. The crew consists of two female students with a male preceptor. The preceptor is a large man with a booming voice and a cheerful, confident manner. In contrast to the preceptor in the previous example, this preceptor tended to intervene more in the calls, often stopping the students and modeling what he thought they should be doing.

Description of kel_HFS_09

As the crew approaches the scene, the preceptor talks to the crew about scene safety and the need to call the police if there are any concerns about the scene. The crew nears the door of the trailer and hears a woman's voice. A man yells loudly. The door is ajar and the preceptor looks into the room. The man yells louder and the woman wails a bit.

The preceptor says "hold on a bit," then physically moves the two students out of the way and strides confidently into the room. The male voice yells, "Who are these people!" The preceptor in a loud but calm voice replies, "Here, sir, what's the problem here? What's going on?" He moves into the room where an elderly couple appear to be arguing. The male patient is also a large man. He holds a beer bottle in his left hand. There are other liquor and beer bottles around the room.

The preceptor quickly steps in between the man and woman, places his arm on the male's shoulder, and turns him slightly. The man sputters and stammers, obviously angry. The preceptor uses his momentum to steer the male towards another room, leaving the two students with the female patient. "It's all her fault!" the male yells. The preceptor mirrors the male's comments and continues to move him gently towards the next room: "It's all her fault . . . come in here with me. I need to ask you a few questions." The preceptor moves out of camera view, continuing to talk to the male: "What happened? Can you tell me what's going on? Would you put the bottle down please? What's going on?" He continues to distract and gradually calm down the male while the students assess the female patient. The preceptor positions himself in the doorway between the two rooms; he blocks the male patient from coming back into the room, yet he can still see and monitor the students.

In both these examples, the preceptors recognized potentially unsafe situations and reacted instinctively, almost unconsciously. In the patient care example, the Vancouver preceptor initially hung in the background, but as he saw and heard more cues—and did not see the students responding to them—he gradually moved physically into the call and eventually took it over. Once the situation was stable, he faded into the background. In both of the patient safety examples, the preceptors seemed to be unaware that they were becoming part of the call.

In the man down call, the preceptor seemed to move without conscious thought—always ensuring that he had a clear view of the patient and positioning himself so he could intervene if the situation became violent. In the domestic dispute, the Kelowna preceptor simply responded at the door to the trailer and used his size and confident manner to separate the two patients and create a buffer zone between them. He created a scene where the students could safely function and that still allowed him to monitor both the male patient and the students' interactions with the female patient.

Summary: Situational roles of preceptors and instructors. The PCP program is built on a simple-to-complex model, with instructional activities designed to help learners build the skills and knowledge they need to enter practice. In this model, as the learners move from *mastery* of Core Skills to their application in increasingly complex situations, the simulation environments become longer and include more information. At the same time, the instructor role moves from active coaching in-the-moment to more facilitative modes of observation and post-call discussion. The interactions of the preceptors in the HF simulations, however, did not follow the trends established in the classroom simulations. The preceptors took on multiple roles as participants in the simulations: coaching and mentoring, and intervening to either mentor or take control of calls when required. The preceptors functioned in a much more involved manner,

using a variety of situational activities to help guide the students through the calls.

Feedback: What the Students Gained From the Simulations

In the previous sections, I explored the structure and delivery of paramedic simulations and the varied roles and activities that instructors and preceptors took in fostering learning. This section looks at how instructors and preceptors used feedback to frame and bring to the forefront specific aspects of the learners' experiences in different simulation environments.

Feedback is a critical component of experiential learning (Fenwick, 2003). Schön (1983) noted, in particular, the importance of two feedback strategies in the development of professional expertise: reflection-in-action and reflection-on-action. Reflection-in-action refers to encountering, framing, and solving problems "in the midst of action" (Schön, 1987, p. 26). By contrast, reflection-on-action takes place after the practitioner has dealt with a situation and focuses on deliberate consideration and evaluation of performance. Within the clinical reasoning literature, Ericsson (2007) posed *deliberate practice* as an effective strategy for developing and maintaining clinical skills. Literature on metacognition (Koriat, 2007) posed two levels of activity: performance and monitoring. In each of these examples, learning is fostered when students become aware of salient aspects of an experience, and, in some way, relate those aspects to both past and future practice.

In the following discussion, I explore how feedback was used within the simulations of this study to cue learners to important features of their experience and to shape their future practice. This section looks at four aspects of feedback: the strategies and activities instructors and preceptors employed in providing feedback, the *target* of feedback, the topics the feedback focused on, and what learners remembered 10 months after the simulations.

Feedback strategies and activities. Feedback provides an intriguing window into the

teaching and learning strategies in simulation. Instructors and preceptors adopted a number of roles in the simulations in this study, and, in these roles, employed different strategies for monitoring, assessing, and prompting change in their learners, choosing different strategies to meet different learning goals. The following discussion describes the strategies and activities that emerged from my analysis. Students in this study received feedback at three distinct points: in-call, post-call, and end-of-lesson (see Figure 12).

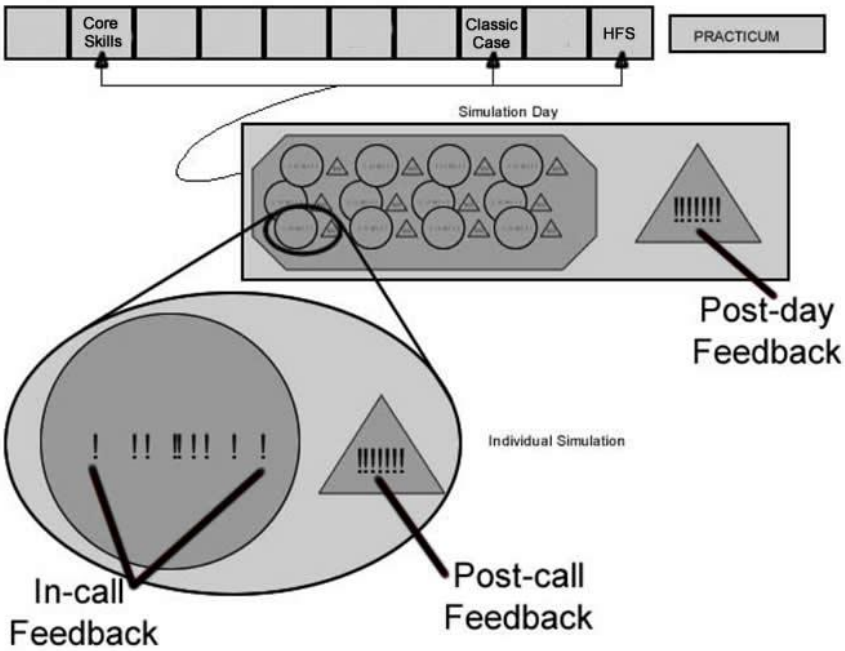

Figure 12. Feedback points in PCP curriculum.

In-call feedback. In-call feedback was present in both the Core Skills drills and the HF simulations. In the Core Skills drills, the instructor monitored all groups as they worked through the scenario. The instructor intervened to correct individual problems and to address group concerns. The preceptors in the HFS setting provided feedback throughout the call in the form of coaching and mentoring. Note that in-call feedback was opportunistic, occurring when instructors or preceptors noted an issue or problem requiring intervention.

Post-call feedback. The most common form of feedback in all simulations was the post-call debriefs. In the Core Skills and Classic Case simulations, each group held an informal debrief at the end of the call. Students often worked in individual breakout rooms and an instructor circulated among the groups. Thus, the post-call debriefs were often peer-driven, with instructors contributing when they were available. The debriefs followed a common format focusing on skill, sequencing, and decision making. The scripts for each scenario often contained prompt questions for these sessions.

The HFS calls ran more like ambulance calls. There was no formal debrief time scheduled between calls. In some cases the crews had 10 or 15 minutes between calls; at other times, another call was waiting when they finished giving their triage report. Thus, the post-call debriefs were informal, and discussion varied in length and depth. However, there was often time to talk about the call while waiting in the mock hospital or while crews were waiting to give reports. Following the triage report, the crew (students and preceptor) released their patient and continued their discussion while they prepared equipment for the next call. Often the patient, along with the Call Manager and triage nurse, participated in the discussion. On occasion, the debrief continued into the next call. The crew was dispatched and walked to the next location, continuing the conversation en route.

End-of-day feedback. I captured video from two forms of end-of-lesson/end-of-day debrief sessions. On the first day of taping Classic Case simulations, the instructors gathered all students at the end of the lesson into a large classroom. A table was set up for each of the simulations that the students had completed that day. An instructor facilitated each table. The crews rotated from table to table. The crews discussed any issues that arose from their own evaluation of the scenario, and then the instructor covered global issues—trends or problems that

occurred across several groups. The second, more traditional form of end-of-lesson debrief was a plenary session where the instructors asked the students to report out on the issues they had documented. The instructors then presented their comments for the day.

The HFS sessions were concluded with a form of post-day plenary debrief session. I conducted an unstructured focus group debrief of each HFS day, asking the participants to describe their experiences. I asked several questions that explored the participants' performance and the types of feedback they received in the day. I also conducted a focus group interview with the six students from the Vancouver cohort approximately 10 months after the HFS day. Again, I asked questions about the feedback they received, the issues they encountered in the simulations, and what they felt they had learned from the day.

Analysis of feedback. The following discussion is based on thematic analysis of the feedback I captured in the simulations, post-call debriefs, post-day sessions, and focus group interviews, along with descriptive statistics gathered from this process. I analyzed instances in which instructors, peers, and preceptors provided feedback, direction, or correction to the learners along with discussion on feedback and learning from the focus group interviews. I generated four sets of codes related to feedback: activity, target, layers, and context.

Activity codes. The participants in the simulations used a variety of activities to provide feedback to the learners. Their feedback was either corrective or explanatory, including *evaluation* (feedback), *tips* (suggestions), *questioning*, and *explanation* (see Table 7).

Table 7. Feedback activity codes

Activity	Definition or examples
Evaluation	Comments or statements that pass judgment on the participants' actions.
Tips	Statements that describe ways of performing a task or activity. Statements are framed as alternative methods, "better ways," ways that activities are performed "in the field," etc.
Direction and/or correction	Statements that explicitly direct students to perform a task a specific way or that provide correction or the "correct" way to perform a task.
Questioning	Questions used to prompt activity or explore the student's knowledge.
Explanation	Statements that elaborate, describe, or explain, such as rationale for a particular way of performing a task.

Note. Table 7 is provided as an example of the coding tables developed in this study. Remaining coding tables may be viewed in Appendix B.

Evaluative comments passed judgment on the learner's actions or choices. Comments coded to tips corrected or directed the students' performance by providing alternative actions, different ways of doing things, and suggestions on how the students might perform more effectively or efficiently. This form of corrective feedback was not framed as evaluative, but rather as elaboration or alternatives, often calling upon situational factors as justification. The preceptors also use questioning strategies to explore students' knowledge base (often leading towards either an evaluative comment or suggestion for alternative approaches) or to prompt the student to perform a task. The final form of explanatory feedback includes comments that explained, described, elaborated, or provided rationale. These comments often followed and elaborated on tips or directive comments. Table 8 displays the distribution of feedback items into these categories.

Table 8. Feedback activity distribution

Source	Evaluative	Tips	Direction	Questioning	Explaining		Total		Evaluative	Tips	Direction	Questioning	Explaining
253 Peers	100%						41		41				
253 Instructor Debriefs (sims)	11%	56%	11%		22%		9		1	5	1		2
253 Instructor Debriefs (tables)	17%	17%	17%		50%		6		1	1	1		3
HFS Kelowna (in call)	3%	45%	23%	23%	6%		66		2	30	15	15	4
HFS Vcr (In call)	9%	30%	24%	28%	10%		127		11	38	30	35	13
HFS Kelowna (Debriefs)	2%	46%	4%	13%	35%		49		1	22	2	6	17
HFS Vcr (Debriefs)	4%	44%	4%	10%	37%		68		3	30	3	7	25
All Sources	16%	35%	14%	17%	18%		365		60	126	93	63	64

Discussion on distribution of feedback. One day of the Classic Case simulations was debriefed in a novel format. The students used evaluation forms and marked their peers through the day. The same simulation was run in each room through the day, and the student crews rotated between rooms. Each crew did one of each type of simulation. At the end of the day, the instructors set up a table for each simulation. The student crews again rotated through the tables and were debriefed by an instructor. The instructor provided commentary and context and served as a point of consistency by validating or tempering the student-led feedback. The results of these debriefing sessions are reflected in the “253 Peers” and “253 Instructor Debriefs (tables)” rows of Table 8. The Classic Case Instructor debriefs (sims) refers to feedback given by the instructors during the Classic Case simulations themselves.

Note that the HF simulations are broken down by location (Kelowna cohort and Vancouver cohort) and by “in call” and “debriefs.” The “in call” comments refer to feedback given by the preceptors during the simulation, while the “debriefs” comments were those given

in the post-call debriefing sessions.

In general, suggestions and tips were the most common form of feedback, accounting for 35% of all comments. Both instructors and preceptors favoured framing their comments as suggestions or alternative approaches. By contrast, directive comments combined for 14% of comments. Only 16% of the total comments were evaluative, with the remaining comments (35%) equally distributed between questioning and explaining. I was particularly intrigued at how few evaluative comments were given by the preceptors (6% of preceptor feedback).

The exceptions were the comments from the Classic Case simulations by peers. As noted above, these comments were gathered from a session in which the students were being taught how to peer-evaluate and assess performance. This format may also explain why the Classic Case instructor comments in the table-based sessions were heavily weighted to explanation. The instructors in these sessions were helping the students understand how the marking system worked and spent more time explaining and justifying their feedback than providing direct feedback. Note also that the Classic Case simulation debriefs occurred at the end of the simulation. The instructors used primarily suggestions and alternatives in their feedback.

Tips, suggestions, and alternatives were the most common form of feedback used by the preceptors as well. In the HF calls, the preceptors provided correction as necessary and used questioning as a form of coaching to prompt and steer the students. This mirrored the coaching and facilitative role adopted by preceptors. In the debriefing sessions, the preceptors focused more on fostering understanding than on performance issues, and tended to explanation, description, and elaboration of the differences between classroom performance and field practice.

In summary, both instructors and preceptors favoured the use of facilitative approaches, most frequently framing corrective comments as suggestions and tips. Feedback given during the

calls tended to use suggestions and questioning strategies to coach and guide the students, while post-call debriefing leaned more to elaboration and explanation. Both instructors and peers in the Classic Case simulations gave more directive and evaluative comments than the preceptors in the HF simulations. These activities support the roles taken by the instructors and preceptors as noted in the previous section.

Topics: Feedback topics. The previous section described how the feedback given by the instructors and preceptors reinforced the roles they took in the classroom and HF simulations. The difference between the two environments was even more apparent when examining the topic of the feedback given in each environment. Peer and instructor feedback was closely matched to the curriculum framework and focus of the learning activities in the JIBC Practice Ladder. Preceptor feedback, by contrast, was difficult to categorize and very situational (see Table 9).

Table 9. Feedback items coded to Practice Ladder evaluation focus categories

	Total Feedback Items	Total items coded		Mastery	Sequencing	Time management	Decision making
Instructor Feedback	28	27		6	5	10	6
% of total items		96%		21%	18%	36%	21%
Peer Feedback	33	28		9	7	6	6
% of total items		85%		27%	21%	18%	18%
Preceptor Feedback	119	25		7	6	1	11
% of total items	180	21%		6%	5%	1%	9%

Instructor and peer feedback was tightly focused on skills, procedure, and decision making related to protocols and treatments. The JIBC Practice Ladder describes common practice learning activities, their goal, and their evaluation focus. Skill stations focus on mastery or correct performance of steps. Drills, which allow learners to integrate several procedures within the context of a (limited) scenario, focus on sequencing. Procedural simulations (used in both Core Skills and Classic Case) integrate assessment and treatment, with an evaluative focus

on decision making. I was able to code almost all feedback from the instructors comfortably into these categories.

The preceptors' feedback was more difficult to code. The preceptors' feedback tended to be more situational and qualitative. Only 21% of the items could be categorized into the Practice Ladder evaluation categories. The feedback was also resistant to coding by topic or theme. I tried several coding strategies, calling upon curriculum topics, curriculum structure, and categories from the *NOCP* (PAC, 2011). The peer and instructor feedback could be coded into curriculum topics such as procedures, assessment, protocols, and teamwork/communication. However, most of the preceptor comments simply would not fit into this scheme. I found that, no matter what categories I tried to put preceptor topics into, I often found myself listing one or more qualifications for doing so. For example, many of the instructor and peer comments were procedural, focusing on sequencing steps in a prescribed order: "auscultate the abdomen before you palpate it," or "reassess the patient when you move her to the cot." The preceptors' comments, however, were more qualitative and situational: "Be thorough when taking your history," or "Do your Secondary [history-taking and physical exam] with a fine-tooth comb."

While the instructors and peers encouraged students to "avoid mixing up BP [blood pressure] and vital signs steps" or to "stay on track, regardless of what the patient is doing," the preceptors' comments frequently spoke to adaptation and contextual performance. In particular, the preceptors focused on adapting the history-taking process to the overall goal of diagnosis and to follow where the data led. One instructor comment was to stay focused and "know what [history] questions you are going to ask next." Preceptors, however, encouraged students to "follow up with your questions; [the answers from] one question lead to the next," to "ask questions in different ways to get the answers you need," and to "adapt your questions to

investigate the actual pain of this patient." While many of these comments fit into curriculum categories such as history taking or assessment, the topics of the preceptors' comments have more to with how to do things well or how to adapt procedures to meet the needs of a particular situation than with providing feedback on the procedures themselves.

There was no consistent pattern to the preceptors' comments, even on calls with similar problems. One of the Kelowna calls involved an elderly man with pain in his left arm and shoulder. The patient had been painting his house all weekend. However, he also had an extensive cardiac history. Thus, determining whether the patient was having a cardiac episode was important. Two crews performed variations of this call. In the first, the preceptor focused on differential diagnosis, providing the students with lists of questions that ruled in or ruled out various causes of the pain. Another preceptor noted that it is difficult to rule out cardiac causes, and therefore to treat the patient as though he were cardiac: "I'd rather have a nurse tell me it's a pinched nerve than notice another crew bring him in doing CPR," he told the crew. In one of the Vancouver HF simulations, the crew responded to a chest pain call involving first responders and an Advanced Care Paramedic crew. This preceptor's debrief focused almost exclusively on working with the different responders and did not directly address differential diagnosis or patient care at all.

The situational aspect of the preceptors' comments was also evident in the apparently contradictory advice that they gave. One preceptor admonished the students to quit worrying about vital signs. In a Kelowna HF simulation (kel_HFS_12), the preceptor told his students not to "reassess, reassess, reassess . . . why? The vitals are not going to change all that much. If you think they're going to change between when you took them there and now, you've got bigger problems than you think you have." Instead, he told his students to "talk to your patient" and get

the paperwork done en route. Yet, in another Kelowna simulation (Kel_HFS_06), the preceptor emphasized the importance of the Secondary Survey as the "map book of our patient." She went on to say that

> that's why, as soon as you get them in the back of that ambulance, you do another set of vitals. Has anything changed there? Has the breathing changed? "Did the oxygen help, sir? Oh, now you have chest pain? When did that start, exactly?"

In kel_HFS_03, the same preceptor told the students to disregard their training and always have a set of vital signs before leaving the scene. Interestingly, in the Kelowna post-session debrief, the triage nurse said that she sees

> crews come in at triage and like, same thing, they're saying, "These are my vitals," and they have vitals every five minutes, and "This is what happened," but the history around what happened and the past history of the patient, like allergies or SAMPLE history or anything else—not a friggin' clue.

In each case, the practitioner (preceptor or triage nurse) was giving advice to the students that differed from the structured approach to patient assessment that the students learned in the classroom sessions.

And the advice given by each practitioner differed from the others, each situated within the context of the overall conversation and the calls in which the advice was being given. The first preceptor's advice referred to a stable elderly woman who was injured in a domestic dispute. She is scared, and the preceptor implied that caring for her emotionally is more important than taking more vital signs. The second preceptor emphasized the importance of both getting and maintaining a mental map of what's happening with an unstable patient, especially in a call where the patient may be in the midst of a severe cardiac episode. And the triage nurse was reminding everyone that assessment is about understanding what is going on with the patient, not merely gathering the next piece of data in the assessment model. Yet, each in their way was focusing on a deeper piece of advice—practitioners have to consider what actions to take, what

order to take those steps in, and what they are trying to accomplish with each action in relationship to the needs of the patient within the context of the overall call.

I was also struck by the relative absence of comments from the preceptors related to, or calling upon, pharmacology and pathophysiology. The preceptors focused their feedback on situational aspects of the students' performance. I circulated the list of preceptor feedback topics to several instructors who were also preceptors and practitioners. I asked for their impressions of the list and whether it fairly represented the types of comments and topics that they had discussed with students when they were preceptors. One reviewer's comment was particularly relevant. He referred to the topics as "a very safe list." He commented that there was nothing in the list of topics that the students could challenge the preceptor on. He was very aware that the students were "far more up" on their clinical sciences and on the textbook approaches to assessment and treatment than he was. He said that he very deliberately stayed away from situations in which the students would either be able to challenge him on a topic or that put him in conflict with the curriculum. He focused, rather, on how things are done in the field and on how to view and react to "real patients." His comments were supported by other preceptors that I spoke to. Another admitted that she did not feel comfortable getting into discussions on pathophysiology with the students—it had been years since she had been in the textbooks herself. Both instructors commented that the list seemed appropriate—the focus of the practicum is not clinical sciences, but putting into practice what the students had learned in the program.

The situational nature of the preceptors' feedback led me to explore other ways of categorizing their feedback. Two trends emerged. The first was based on the target of the feedback, the second was based on the nested layers of my initial model of fidelity.

Topics: Target. I noted that instructor feedback was generally targeted on the students'

performance of the call-at-hand. In other words, instructors gave feedback that was directly related to what the students had just done. By contrast, I noticed that preceptors seemed to call upon the call-at-hand, calls the preceptors had done in the past, as well as calls the students would be doing in the field in the future. I developed four codes that described the target or focus of the feedback (see Table 10).

Table 10. Distribution of feedback by target

Source	This call	Calls like this	In the field	One like this	Total	This call	Calls like this	In the field	One like this
	Percentage					**Number of Items**			
253 Instructor Debriefs (sims)	85%	8%	8%		13	11	1	1	
253 Peers (tables)	98%	2%			41	40	1		
HFS (in call)	71%	20%	9%	1%	172	122	34	15	1
HFS (post debrief)	37%	20%	39%	3%	115	43	23	45	4
All HFS feedback	57%	20%	21%	2%	287	165	57	60	5

Not surprisingly, the peer and instructor feedback from the simulations in Core Skills and Classic Case was almost exclusively targeted on the call-at-hand. The preceptors, however, used the feedback in a far more asynchronous manner. Their feedback was targeted at both the call-at-hand and on calls that the students would do as future practitioners in the field. In addition, the preceptors used their own experience ("I did one like this") as both justification and example for feedback.

Instructors, peers, and preceptors generally targeted most of their feedback on the call-at-hand. This type of feedback was directive, in the form of suggestions, and targeted at specific tasks or functions, such as in vcr_HFS_18, when the attendant wants to roll a patient with abdominal pain onto his side. "He doesn't have an airway problem," the preceptor says. "Don't roll him."

Preceptors also targeted feedback towards future practice, using advice on some aspect of the current call to suggest how the students should perform similar calls in the future. In a Kelowna HF simulation (kel_HFS_07), a preceptor discussed the importance of making sure the students got enough history, even on a trauma call where the priority is to package and transport the patient as quickly as possible. “If there’s someone there that has information you need, but you don’t have time to get it from them, bring ‘em along.” The advice spoke to how the students acted in the current call but was targeted more towards future practice.

The preceptors called upon the concept of “how things are done in the field” in a similar vein. In this form of feedback, the preceptors distinguished between how the curriculum represented practice and how the students would be expected to practice once they graduated. One preceptor repeatedly reminded his students that, despite how their training protocols are written, “in my ambulance, if he [the patient] is going to get an IV in the hospital, I’m going to start it in here.”

The following example is from a post-call debrief of a Kelowna HF simulation in which the preceptor presented advice to the students that directly contradicted their training.

Excerpt from kel_HFS_06:

PCP1: Student in the role of attendant
PCP 2: Student in the role of attendant
Preceptor: Field paramedic in the role of preceptor

Preceptor: Oh, yeah, you always take a . . . you need to have a first set of vitals?
PCP1: On scene?
Preceptor: Yeah. Yeah.
PCP1: Really?
PCP 2: If it’s a load and go, do you load and go and get your vitals in the car?
Preceptor: I have never done that. My initial set of vitals is my starting point. So . . . how long did it take us to get that patient loaded?
PCP1: A while.
Preceptor: A while. How do you know what he was when you first got there and he didn’t deteriorate more?

PCP1: Well, you see, the thing is that if I would have got there, he would have been confused and I would like have to skip, skip, drag it out of him . . .
Preceptor: Mmmm hmmm.
PCP1: So, right now I know, I'm doing my primary, and he's getting the cot, and it would have gone—
Preceptor: But a part of your primary is a set of vitals.
PCP1: No.
Preceptor: You need a base set of vitals.
PCP 2: In our training, it hasn't been that way.
PCP1: Yeah, we have a card that has our primary . . .
Preceptor: But vitals are like your base, right?
PCP1: Oh, yeah, I agree with you, but—
PCP 2: But we've been taught our ABCs [airway, breathing, circulation], pulse check, RBS [rapid body survey], O2 [oxygen], transport.
Preceptor: But he hasn't . . . he's got an airway. He's got breathing, he's got circulation. . . . Those are life and death right there. He's unstable because he's got an altered LOC [level of consciousness].
PCP1: But you would have done vitals on scene?
Preceptor: I need to know why he's unconscious.
PCP1: That's not at all like we've been taught.

The preceptor based her feedback on her own experience and practice. She acknowledged the students' training, but pointed out that, in the field, situational factors change the time frames that practitioners have for dealing with procedures. The students' patient assessment algorithm indicates that transport is an immediate priority and taking vital signs should be done once the crew is en route to hospital. Yet, the preceptor noted, there is usually time to obtain the vital signs while preparing the patient for transport and moving to the ambulance. She has "brought forward" taking the vital signs without delaying transport. Her practice is based on her perception of the differing priorities of "knowing what's going on" and transporting as quickly as possible. As in the previous example, "in the field" comments called on past practice to support advice on how the students should perform in the future, once they are themselves in the field.

The final category was used to code instances where preceptors recalled a specific incident from their past and used it as a case to illustrate the point they were trying to make. Although I had initially thought that this would be a common strategy for the preceptors, it was

rarely used during the simulations and debriefing sessions I recorded.

Topic: Layers. I also called upon the complexivist concept of the nestedness of the simulation environment to categorize the feedback. I started by deriving categories from my initial model of fidelity and discovered that this provided useful distinctions between the instructors' and the preceptors' comments. The categories were further expanded by calling upon the coding framework for interaction between participants and elements of the simulation environment (see Table 11).

Peer and instructor feedback from Core Skills and Classic Case simulations was heavily focused on four areas: performance of the attendant, functioning in a simulation environment, call management, and use of specific treatment guidelines and protocols. Recall that the Classic Case debrief session was structured around familiarizing the students with how to use the evaluation system. This accounts for the focus on feedback that related to use of the simulation environment, such as verbalizing findings and performance of non-observable tasks. The instructors' feedback ranged slightly broader than that of the peers, but remained primarily focused on call management and treatment. This closely matches the learning objectives and goals for the simulations.

Table 11. Distribution of feedback by layers and/or focus

	Number of Items	immediate environment	Injury/condition	patient as person	patient as problem	bystanders family	attendant	partner	preceptor	other responders	equipment	broader environment	simulation	curriculum	time management	call environment	call management	protocol or treatment	treatment	community of practice	social setting	social setting	culture
Peers (253)	89			2			10						37		7		20	8	2		2	1	
				2%			11%						42%		8%		22%	9%	2%		2%	1%	
Instructors (253)	73	2	1	2	3		6	2		1	4		22		3	2	15	8	2				
		3%	1%	3%	4%		8%	3%		1%	5%		30%		4%	3%	21%	11%	3%				
HFS (in call)	211	11	7	2	20	7	0	7		19	21	1	3		4	10	53	11	11	18	6		
		5%	3%	1%	9%	3%	0%	3%		9%	10%	0%	1%		2%	5%	25%	5%	5%	9%	3%		
HFS (Debriefs)	192	5	10	7	25	5	14	14	2	8		8	4	4	10	5	47	2	2	16	3	1	
		3%	5%	4%	13%	3%	7%	7%	1%	4%		4%	2%	2%	5%	3%	24%	1%	1%	8%	2%	1%	

The preceptors' comments ranged widely. The largest concentration was on call management (24%), with a significant drop to areas such as patient as problem, interacting with other responders, use of equipment, and references to practice in the field (each between 9% and 10%). However, the remaining feedback was distributed across almost all fields in the coding model. Instructors and peers made few or no comments relating to the immediate or broader physical environment of the simulations, other people in the simulations (bystanders, family, other responders), the curriculum, field practice, or social or cultural concerns. In the post-call feedback, preceptors tended to focus on discussions around call management, the patient as an instance representing a particular condition, and practice in the field.

Two features are interesting in this discussion. The coding framework looked at how feedback related to the elements of fidelity that were enhanced in the HF simulations. And, when placed in a HF environment, the preceptors noticed, acknowledged, and used these features in their feedback to the students. The second interesting feature is the distribution of the preceptors' feedback. The most common comments are on overall call management, which seems quite reasonable. However, when the preceptors' in-call and debriefing comments are combined, the remaining feedback is widely distributed, with no categories dominating. Thus, preceptor feedback is very idiosyncratic and situational.

Topics: Contextual analysis. The previous analyses of the topics of feedback showed that the preceptor feedback is diverse and highly situational. The contextual flavour of the preceptors' interactions led me to consider how feedback related to the Dreyfus (2001) model of skill acquisition, which acknowledges the increasing importance of context to the development of proficiency and expertise. The descriptions and examples in Dreyfus' (2001) model provided two characteristics by which to judge the contextual complexity of the feedback given by

instructors and preceptors. One set of characteristics refers to the richness and importance of the environment; the second set of characteristics describes the generalizability of the rules employed to make decisions.

I chose to not code the feedback topics themselves to the Dreyfus (2001) categories. The Dreyfus (2001) model looks at the features of the environment and the context-dependence of decision making. Thus, I looked at the *advice or direction* that the preceptor gave and *how much context* was called for to use that advice (see Appendix B, Table B3). For example, in kel_HFS_05, the preceptor stated, "You don't want to Code X a patient with arm pain, then have to respond later to a cardiac arrest call." This statement is categorized as a Proficiency statement involving a decision between alternative, acceptable choices. Each choice is acceptable, although each has benefits and risks. The attendant must choose which features in the case to consider salient, then choose an appropriate course of action. By contrast, in the Classic Case peer-led debriefs, several students critique peers for waiting too long between taking sets of vital signs. According to the curriculum, vital signs should be taken every five minutes. This is a context-independent statement that does not consider contextual features such as how to integrate taking vital signs with the need to move the patient down a flight of stairs or dealing with uncooperative bystanders. Thus, these statements are categorized as Rules in the Novice level.

This coding framework provided useful distinctions between the feedback given by peers, instructors, participants, and preceptors (see Table 12). I was also able to use the coding framework to code the end-of-day sessions in the HF simulations and the follow-up focus group interview with the students from the Vancouver cohort.

Table 12. Distribution of feedback in relationship to Dreyfus (2001) categories

Dreyfus Categories:		Non-situational features	Rules	Situational aspects	Principles/Maxims	Aspects w/importance—salience	Develop plan based on aspects/salience	Situational discriminations	Decide on alternative plans based on salience	Vast repertoire of intuitive perspectives	Intuitively appropriate action	Subtle and refined discriminations
Feedback Source		**Novice**		**Advanced Beginner**		**Competent Performer**		**Proficient Performer**		**Expertise**		
In-Call Feedback												
Core Skills—Peer			55%	18%	18%							
Classic Case—Peer	19		68%	5%	26%							
Vancouver HFS Students	12			25%		58%	17%					
Kelowna HFS Students	6	33%				33%		33%				
Classic Case Instructors	8			13%	50%		13%		25%			
Vancouver HFS Preceptors In call	75		9%	19%	12%	7%	39%	5%	5%		1%	
Kelowna HFS Preceptors In call	11	12%	4%	20%	12%	8%	8%	20%	12%	4%		
End-of-Day Feedback												
Post HFS Sim All Preceptors	6					25%	25%	8%		42%		

Peer feedback in the Core Skills and Classic Case simulations was focused almost entirely in the Novice and Advanced Beginner categories. Peers tended to provide rules and guidelines and made only limited discrimination of cases based on contextual factors. Recall that these students are new to EMS and have little or no background in patient care. Thus, their experience is limited to the simulations that they have encountered in the program. And so, the leveling of their feedback is both appropriate and to be expected.

The Classic Case instructor comments were also heavily weighted to low context factors, with 63% of the feedback focused on rules and principles. Yet, fully a quarter of the instructors' comments are encouraging students to choose between acceptable alternatives based on contextual factors at Dreyfus' (2001) Proficiency level. For example, in vcr2_220_10, the instructor is discussing whether to use spinal precautions on a patient with a head injury. In the

scenario, the patient has a laceration on his scalp, but the mechanism of injury is not sufficient to cause spinal injuries. The instructor tells the student, “If the patient is conscious, you can use questioning to quickly rule out D-spine.” The general (context independent) principle is to treat any patient with injuries above the clavicle (collarbone) as a spinal patient. But the instructor offers two acceptable options: treat per the rule, or consider the situational aspects and use questioning to rule out spinal injury. Even though the curriculum structure is based on a novice-to-expert continuum and the objectives of the lesson at this point in the curriculum are rule- and guideline-based, the instructors are offering context-dependent choices to the students.

The preceptors, in contrast, provided comments seeking competence, proficiency, and expertise. Almost half of the preceptor comments focused on adaptation, situational discrimination, and experience-based decision making. The end-of-day discussions, where the preceptors talked about their experiences in the simulations overall, were even more heavily weighted to consideration and discussion of contextual and experience-based factors.

I also coded the comments from students in focus group sessions immediately after the HFS session and from an interview with the Vancouver HFS cohort six months after the HFS module (see Table 13). The students in the HF simulations participated in a focus group discussion at the end of the HFS sessions. In these discussions, the students discussed their experiences and recollection of the HF simulation day. The students’ comments were very similar between the two groups. The students identified several facets of the day as enhancing their learning, including the use of actors and authentic personnel in the roles of patients, bystanders, and other responders. Several students noted that they had tunnel vision, either not making good use of the other responders or in never having had patients that did not require treatment. They appreciated not feeling as though they were being graded and having the preceptors guide and

coach them. Half of all the students' comments referred to having rich environments where they did not know what was going on, had to deal with unexpected responses from patients and bystanders, and had to learn how figure out what was important in the call.

Table 13. Distribution of feedback in post simulation and post program interviews in relationship to Dreyfus (2001) categories

Dreyfus Categories:		Non-situational features	Rules	Situational aspects	Principles/Maxims	Aspects w/importance—salience	Develop plan based on aspects/salience	Situational discriminations	Decide on alternative plans based on salience	Vast repertoire of intuitive perspectives	Intuitively appropriate action	Subtle and refined discriminations
Feedback Source	**n**	**Novice**		**Advanced Beginner**		**Competent Performer**		**Proficient Performer**		**Expertise**		
Students Post HFS	18	11%		17%		50%	11%	11%				
Vancouver 2010 Student Interview	66	2%	3%		2%	27%	12%	14%	11%	30%		

In addition, the Vancouver cohort students participated in a follow-up interview in early 2010. The labour dispute that interrupted the study had just ended, and the students were returning to the JIBC for additional practice before finally being able to participate in their practicum. Several of the students had moved on to work in the ambulance field. Thus, the students in this interview had the benefit of time for reflection and some experience. The majority of their comments focused on the appreciating the richness of the environment, obtaining experience in dealing with novel and random situations, using multiple personnel from different agencies, and having to deal with the unique features of every call.

There was, however, a noticeable shift in their comments in relationship to the Dreyfus' (2001) categories. In the focus group immediately after the HFS modules, over 38% of the students' comments were in the Novice and Advanced Beginner categories. Yet, in the follow-up interviews several months later, only 7% of comments focused on Novice and Advanced Beginner items. Thirty-nine percent of the post-HFS comments were aimed at proficiency, while

54% of the subsequent interview comments were focused on issues relating to proficiency and expertise.

Discussion: Situational feedback strategies. In this section, I sought insight into what the learners gained from the HF simulation environment by analyzing the feedback students received from their peers, instructors, and preceptors, as well as feedback the students gave on their experiences. Preceptors and instructors used different sets of strategies and activities that focused on different aspects of the practice learning environment.

Instructors used more evaluative and corrective activities, usually in post-simulation debriefing activities. They called less on the context of the situation, framed their responses through rules and principles, and tended to target their feedback to the students' performance-at-hand. The feedback of both instructors' and peers' was tightly bound to the stated objectives of the current simulation and focused on call management, the attendant's choices and actions, and how learners should function in a simulation.

The preceptors used feedback in much different ways. The preceptors provided feedback through coaching and mentoring during the calls and in informal discussions between calls. Their feedback was more situational and context dependent. Their in-call feedback used coaching activities to cue students to important aspects of the environment and salient features of the patient's presentation. While students in classroom simulations commit errors and receive corrective feedback at the end of the call, the preceptors tended to intervene either to steer or, occasionally, take over a call to ensure patient and crew safety. Post-call feedback used the experience of the simulation to look forward and address how students should perform in the field, rather than focusing on correction of behaviour in the moment. The topics of feedback were idiosyncratic, situational, and context-driven. The preceptors were not working from

predetermined objectives; they must assess each situation and create a framework from which to determine what feedback they should give the students. What initially appeared as contradictory advice at a rule-level was usually advice framed within the unique context or particular needs of specific situations.

Several points were particularly interesting for this study. First, both the topics and the aspects of the simulation environment addressed by the preceptors varied widely. The preceptors were aware of, and make reference to, the rich situational and contextual factors in the HF simulations. The preceptors used these factors to provide situational feedback to the learners aimed at adaptation, situational discrimination, and choosing between alternative acceptable options—characteristics found in Dreyfus' (2001) categories of Competence and Proficiency.

Second, the preceptors called upon strategies to encourage both reflection-in-action during the calls and using reflection-on-action (Schön, 1987) in post-call discussions to pose more forward-looking feedback. In-call feedback was usually framed as tips and alternatives focused on developing plans and adaptation to meet contextual aspects of the current call. Post-call feedback was more situated to the future, with preceptors relating reflection on the immediately call with previous experiences.

Feedback summary. Both instructors and preceptors used feedback to guide and direct students. However, their forms of feedback varied. Instructors and peer evaluators tended to give feedback tagged to curricular goals and focused on the call at hand, and calling upon Dreyfus' (2001) context-free rules. Preceptors gave situational and context-dependent feedback that encouraged students to develop awareness of the overall scene and to discriminate and recognize salient aspects of each unique situation. Instructors' feedback generally promoted consistent performance, while preceptors' feedback was forward looking, providing more qualitative

suggestions on how to tailor performance to the specifics of each individual call.

Teaching and Learning in Simulation Summary

This section examined three aspects of how simulations foster learning: the emergence of pedagogic practice matched to specific types of learning outcomes, assumption of a variety of roles by instructors and preceptors to foster different types of learning, and the adaptation of feedback to frame and forefront specific aspects of students' learning.

Teaching and learning are linked processes that come together in complex ways to form effective learning environments. The varied practice learning environments in this study called upon different patterns of structure, fidelity, and activity to foster effective learning. While some aspects of fidelity are enhanced in more complex simulation environments, some intriguing exceptions emerged. Procedural fidelity is high in almost all simulation formats. In contrast, some forms of verbalization and imagination are employed in even complex environments. Thus, the patterns and relationships between different aspects of fidelity and learning goals are neither linear nor necessarily predictable.

The design of the PCP curriculum deliberately manages the degree of instructional scaffolding and control in different simulation environments. As learning goals move from highly prescriptive skill sequences to integration of previously learned procedures in novel situations, instructional roles move from in-the-moment coaching towards more reflective and observational activity. However, the interactions of the preceptors with learners significantly challenges this structure. As learners move into the practicum setting, instructional scaffolding does not further recede; rather, preceptors become active participants in the simulations. Their intervention is situational and context-driven as they both help learners adapt to the new setting and ensure safety for patients and practitioners. Preceptors take on a variety of coaching,

facilitative, observational, and mentorship roles as individual learning opportunities present themselves.

Instructors and preceptors not only engage differently with the simulation environment, but they structure and use feedback to support their varied roles. Instructors and peer evaluators tend to give feedback tagged to curricular goals and focused on context-free rules. Preceptors give situational and context-dependent feedback that encourages students to develop awareness of the overall scene and to discriminate and recognize salient aspects of each unique situation.

These findings emphasize the variability and interconnectedness of various elements and aspects of the simulation environment. Different learning goals lend themselves to the creation of different types of simulation activities, use of alternative instructional strategies, and multiple forms of engagement between participants.

How Do Participants Interact and Function in Simulation Environments?

One of my underlying assumptions in this study was that enriching the simulation environment changes the interactions of the participants with that environment. I created a simulation environment that allowed interactions more closely resembling field practice. Participants were able to obtain information directly through observation, questions, interaction with the physical environment, and through interactions with each other that more closely resembled everyday engagements. Somewhat surprisingly, participants took uneven advantage of the enhanced environment, dynamic aspects, and interactive players in the scenarios.

I explored the participants' experiences and interactions in this environment through an inductive and iterative process of observation and coding. I began with an initial set of codes based on my definitions of clinical judgment and fidelity, calling upon the concept of nested, complex phenomena. My initial codes evolved, and new patterns of interaction emerged that

became additional coding frameworks that categorized who and what participants interacted with, what the participants were doing, how immersed they appeared to be in the calls, and how authentically they were performing tasks and procedures. I used the coding process to create interaction maps for attendants, drivers/partners, and preceptors—graphic representations of the distribution of their interactions over time in a call. I analyzed these maps for patterns of interaction between participants and their environment. I also created collections of analytically interesting clips that further explored how the participants engaged with each other and their environment.

The following discussion looks at how participants interacted with the HFS environment through two broad themes: function and role of the participants and immersion in and discernment of the environment.

Function and Role of Participants

I entered this study with a conceptual model of fidelity that identified a variety of agents and elements of a simulation environment that a participant might interact with. This model became the framework through which I chose which facets of the environment to enhance. The following discussion explores three aspects of the participants' interactions in the simulation environment: who and what they interacted with, what they were doing, and how authentically they performed those actions.

Who and what did participants interact with? I began by creating a set of codes based on the layers of fidelity that I used to develop the simulations. The codes evolved with use, particularly in relationship to the interactions of the attendant and the patient (see Appendix B, Table B4). I initially coded the calls from the perspective of the attendant, although I later added codes to analyze the interactions between the attendant, partner, and preceptor. I created an

interaction map (see Figure 13 for an example) for each call and also gathered instances of analytically interesting clips into collections for further analysis.

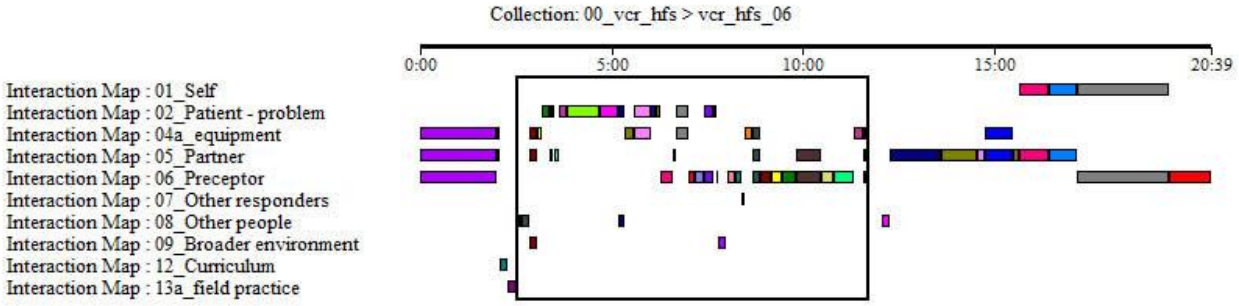

Figure 13. Sample interaction map.
NOTE: Left axis represents the codes describing who/what the participant was interacting with. The horizontal access represents time during the simulation. Coloured segments represent individual video clips of an interaction. Colour coding is only to distinguish between clips –the colour itself has no significance. In this simulation, the first 2 minutes show that the participant was interacting with the partner and preceptor, while using equipment en route to the patient. The boxed area represents the segment of the simulation where participants were with the patient.

The interaction maps provide graphic representations of the interactions of the attendants with the selected elements of the environment. Note that the sample map in Figure 13 includes the set-up to the scenario (the first two minutes while the crew is en route to the scene), approximately 10 minutes interaction with the patient (the area bounded by the box), and the post-scenario discussion and debriefing session. I used the interaction maps to look for patterns, which I then investigated through reviewing the videos, transcripts, and journal notes.

Interaction between participants. The simulations in this study were explicitly created to provide situations in which participants would encounter and interact with a rich physical environment, bystanders, family members, other responders, and medical personnel. As noted earlier, the preceptors frequently gave feedback encouraging participants to engage with these agents and factors. However, the students' engagement was uneven at best and tended to be cursory. Although the students did encounter and engage bystanders, the physical environment,

and other responders on most calls, the interactions were often short verbal exchanges that focused on obtaining brief history. The significant exception was the richness of the interactions between the students and the preceptors. The following discussion explores these findings in more depth.

Patient interactions. The patient is at the centre of paramedic practice, and it is not surprising that the primary interactions in all categories of simulations remain those between the attendant and the patient. The classroom simulations—Core Skills and Classic Case—tend to focus on interactions between the attendant, patient, and equipment. The instructional focus of Core Skills is establishing core paramedic skills and procedures, most of which involve manipulation of equipment. Classic Case provides learners with the opportunity to integrate and practice these procedures in the context of classic presentations of common ambulance calls. Thus, the focus on patient and equipment is both reasonable and expected. These interactions remain fairly constant in the HF simulations.

I had expected the HFS participants to engage with the patients on several levels. In the classroom simulations, students play the role of patient, and participants must pretend that their colleagues exhibit the age, gender, physical presentation, and physiological findings called for in the scenario. The HF simulations were explicitly designed to increase the physiological, interpersonal, and social/cultural aspects of fidelity. The actors used their own personal health histories (several patients had histories consistent with the conditions they were portraying) or were given richer backgrounds to portray. Yet, there were few instances of the participants in the HF scenarios interacting with their patient as a person with a health and life history. The attendants' questions tended to assess in a rote fashion, with little follow up or exploration of the information. Few attendants explored the recent health histories of their patients. There were

occasional inquiries as to patient comfort, but few interactions that explored—in any way—the lives of the patients beyond the immediate moment that the participants were in.

The preceptors encouraged the students to take richer histories from their patients throughout the HF days. In one HF simulation (kel_HFS_05), a preceptor remarked that the patient was a better historian than most:

> Be really thorough on that assessment. The big thing for me is he knows his history. He knows he has a cardiac history, he knows he was at the Royal Jubilee [hospital], he knows he had an angiogram and four stents and a follow up—that's a pretty good history. Most people would tell you that "they stuck a bunch of things into my heart."

The preceptor encouraged the student to take advantage of such a rich history, even though they performed a "reasonably good history taking. It took a little bit of prompting, but all that comes from experience, following up on questions. One question leads to another question." The preceptor in kel_HFS_10 told his students that "some patients don't necessarily answer your questions. So keep asking the questions a lot of different ways and over and over again."

Very few of the attendants engaged with their patients on a personal level. At most, attendants would ask the patients if they were comfortable during lifts and transfers. Rarely did they inquire about their patients' emotional or psychological responses to the situations they found themselves in. In vcr_HFS_12, the patient is an elderly man who is complaining of chest pain. The attendant is performing an RBS, looking for injuries or abnormalities. He asks questions about the patient's chest pain. "Does it radiate anywhere?" he asks. "Do you feel it up your arm or leg or anything?" The patient laughs nervously and says, "No. I just feel stupid." The attendant does not react at all. He continues checking the patient's hips and asks, "Okay, does that feel any pain there?" The patient is obviously uncomfortable and worried. Yet, the attendant chooses not to respond to the patient as a person, continuing, instead, to perform his assessment actions. In vcr_HFS_12, the crew responds with police to a residence. They find a

man in cardiac arrest. His wife is hysterical. She came home to find the patient lying on the living room floor, apparently shot twice. The crew immediately begin resuscitation attempts on the male, but neither react to or interact with the woman.

In the debrief at the end of the Kelowna session, one of the preceptors expanded on the need for the students to learn more about their patients' backgrounds and histories:

Excerpt from Kelowna HFS Post-Session Interview:

Preceptor: How many of you actually learned something personal about the patients you had to look after? Like actually found out something about them? Something beyond their name? What they did before they retired? Or, what are their hobbies in their home? . . . But some of the most interesting people I've ever met have been patients. If you work in a small station and you're going to go from Applewood to Fort St. John and you have a patient . . . well, you have to learn how to talk to people. And, I used to carry a guy weekly from Merritt to Chilliwack and back. And he helped build the Kettle Valley Railroad. For ten cents an hour. He went from 5 cents an hour in the coal mine to 10 cents an hour building a railway. And he was probably the most interesting guy I ever met. Uhm, but if you can take the time to—because part of what you do is build rapport with your patients And, when you start out, most of your report is going to be read by [inaudible]. You need to get that information. That's a big part of your job.

Social milieu. The students' focus on their patients' medical presentation also limited their interactions with the social environment in which the participants were immersed. The focus of the current curriculum is on patient care. But an ambulance call is always situated within larger social and cultural contexts. Although the HF simulations contained rich social environments, the students tended not to engage with these broader facets. Bystanders in several of the simulations had important information about either the patient's background or the history of the event. In general, the students had short initial exchanges with bystanders and family—often one or two questions to determine a chief complaint. They rarely followed up on the information they received or explored with the bystanders other potential issues or concerns. There was almost no exploration of the patient's history or status outside the immediate episode.

Description of kel_HFS_12

An elderly woman falls and has a hip injury. Her two companions are elderly men. In the

scenario, the men constantly get in the way of the crew and keep offering assistance. The call is outdoors, next to a commercial building. An elderly woman lies on her side on a cement wheelchair ramp. Two elderly men are standing near her. Both look anxious. The two students approach and leave the stretcher about two meters from the patient. The preceptor walks alongside them. The attendant asks what happened, then kneels down to start assessing the patient. The two men hover closely. One states he had first aid as a boy and can help. Twice the attendant asks the two men to move back and not touch the patient.

The attendant in this call focuses exclusively on the patient. She does not see the bystanders as sources of information that could tell her what happened or indicate how serious the patient might be hurt. Rather, she sees them as obstacles to what she wants to accomplish. The preceptor lets her start the call but realizes that she is not dealing effectively with the bystanders. He then intervenes and moves the bystanders to the side of the scene. The two students continue with their assessment while he interviews the two men. He discovers that the patient has had a recent history of tripping and falls. As well, she has been "going strange" and they have been trying to convince her to go into a care home.

Note that the preceptor not only distracted the two bystanders but obtained important information from them. While the students in many of the calls asked one or two questions when taking a history, this preceptor explored the cause of the accident, picked up on the bystanders' comments, and determined that the patient had a pattern of increasingly frequent falls. He passed this on to the attendant. However, the attendant did not follow up with either the patient or the bystanders. In her hospital report, she stated that the patient had been dizzy for the last few days, but she did not pass on the information that the patient was having a hard time coping at home and that her friends thought she required assistance.

In the post-simulation day debrief, this student recalled the incident and said,

Some of the bystanders were a real pain in the butt today, but that helped, too. They were forcing you to pay attention to them as well and say, "Here! I have to deal with you taking first aid 50 years ago."

The students tended to focus on the patient and missed important aspects of the overall situation. Several of the calls were set as domestic disputes. One Kelowna call involved an elderly couple in a trailer park. In this simulation, the crew treated the elderly female patient, who was scared, had a cardiac history, and had bruising on her arm. The preceptor moved the

aggressive male into a different room and distracted him, but did not treat him as a potential patient. Even though there is an obvious history of violence, the crew does not explore the incident to see if there might be injuries to the man or if there might be some medical issue underlying his behaviour. He appears intoxicated and has a beer bottle in his hand on arrival. Yet several serious medical conditions can mimic intoxication.

The bystanders and family are often not recognized as potential information sources. Indeed, the crews often viewed the bystanders as distractions and noise that was complicating the calls. In vcr_HFS_05 (a pedestrian struck call), a second accident occurs while the crew is attending to the pedestrian. There is the sound of squealing brakes and a horn, then a crash. The crew members look up briefly but immediately return to their patient. About 30 seconds later, a female bystander approaches one of the police officers. She calls out to the paramedic crew that there's been an accident. The crew ignores her. She calls out again and starts walking towards them. A police officer blocks her approach. The preceptor looks over his shoulder and asks the officer to "make sure you control those people, please."

The crew members in this call not only ignored the second incident, they deliberately chose not to react to the bystander who was asking for help. As in the Kelowna simulation with the two over-eager friends, this bystander was framed as a distraction that must be controlled.

Other responders. An emergency call is a social experience that may involve responders from multiple agencies. A student may role play as a first responder role in classroom simulations, or the instructor may verbalize the actions of an imaginary first responder ("You've got a first responder stabilizing the head for you."). A variety of responders participated in the HF simulations.

The students tended to have very cursory interactions with the first responders and

seemed unsure of how to interact with personnel from the other agencies. In most cases, the students entered the scene and received a report from the attending first responder. They then started their call and rarely interacted with the first responders again. As noted in the example in the previous section, one crew attending a pedestrian struck call walked within feet of police who were interviewing a witness and did not stop to ask for any report at all. In an interview in early 2010, the attendant recalls a situation where

> it was interesting at the accident scene, seeing the car and seeing the policemen do their thing and I thought, "Oh! I gotta go do my own thing," and so I just had tunnel-visioned onto my patient, and I wound up not knowing the mechanism of injury and not looking at the crash site and it, it was good, but it threw me off at the same time.

Despite this, the presence of the first responders had a significant impact on the participants. In the post-simulation interviews, several students noted that having the other responders was one of the high points of the day for them. They noted, however, that they really were not sure how to react and interact with these responders. In the Vancouver post-session interview, one student recalled a simulation involving a cardiac arrest. They arrived to find the first responders already doing CPR. She recalled that it was different,

seeing the fire actually on scene, it was like, was actually seeing the job that you know that they can do—I found that different just delegating because I'm just uhm, 'cause you always know that everyone in your class all know CPR.

She had to monitor the fire fighter's performance and ensure that he was doing CPR to the same standard an ambulance crew would use. Another student commented,

> I saw them there on the first call, but I didn't interact with them and then, like, on the next call I didn't find out how the . . . how the accident happened. So, sometimes I didn't bother to ask them, and they had to offer to help, but you know, just having them there was like, this is really cool, it's all real and everything like that.

Other students noted the positive impact that these experiences had on them, helping them to understand how fire and police function in the field. In class, the role of the first responder is either verbalized or performed by a student. But, in the HF simulations, a Vancouver

cohort student said,

> We were dealing with multiple people—so we had cops there, fire there, lifeguards across the street. . . . So different people with different training, and you have to deal with them, and they'd come up and ask, "What's going on?" Instead of you being first on scene and doing the initial assessment, so . . . you were coming in trying to get information from them and deal with the patient at the same time.

Partners and preceptors. Perhaps one of the most striking changes for students in the HF simulations was in the role of the driver. Classroom simulations isolate the attendant as the primary participant, restricting the driver's role to acting under direction. Crews in the HF simulations were encouraged to function in more authentic roles. The drivers were told to act as full partners in the call. In addition, the preceptors were active participants in the calls, not detached observers who provided feedback at the end of the call.

The interaction maps in Figure 14 compare interactions with the partner (driver) in Core Skills, Classic Case, and HF simulations. The number of segments coded to Patient (patient–problem, patient–person) and Equipment remained relatively consistent between the three types of simulation. In the HF simulations, however, the partner starts to take on a more active role. Even in calls where the partner is more active in the Core Skills and Classic Case simulations, these interactions tended to occur in the Primary Survey and the Treatment phases of the call. In vcr2_220_01over half the attendant:partner interactions occurred when the attendant was directing the partner during application of the Sager splint. In general, the attendant interacted more with the partner in the HF simulations than in the Core Skills and Classic Case calls. In the HF simulation in Figure 14, both the partner and preceptor were actively engaged throughout the entire call.

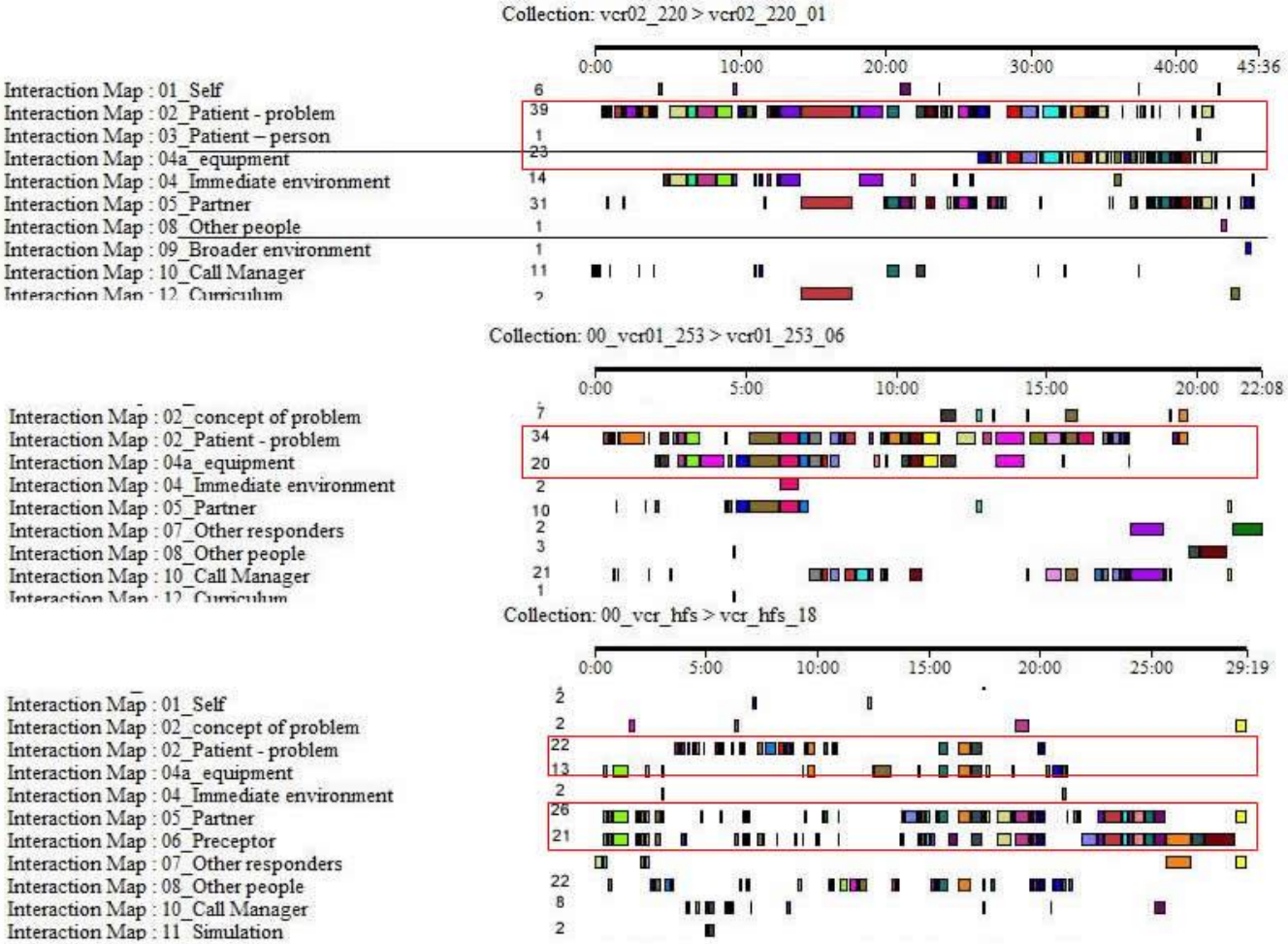

Figure 14. Interaction patterns comparing interactions with the partner (driver) between Core Skills, Classic Case, and HFS simulations. Boxed areas highlight interactions with the patient, partner, and preceptor.

The preceptor took a direct and active role that was significantly different than that of the call manager in the classroom simulations. In the Core Skills and Classic Case calls, the call manager provided verbal information to the students—vital signs, physical findings, and additional history information. The use of actors and HF mannequins in the HF simulations reduced the reliance on the call manager. Students obtained the information they required directly from the simulation environment. The preceptor's role was more active and more direct, both coaching and providing assistance as a member of the crew (see previous section on Role of the preceptor for a more detailed discussion).

Participants interactions summary. In summary, the participants in this study entered a rich, immersive environment populated with a variety of people, physical features, and situations. However, despite ongoing prompting from preceptors, the students tended to focus on the patient and presenting problem, rarely engaging with the broader environment in a sustained way. However, in subsequent interviews, the participants indicated that they were aware of the environment and acknowledged that exposure to the rich settings provided valuable experience.

The following section explores a second facet of how the participants engaged with the simulation environment through an analysis of their actions and interactions.

What the Participants Are Doing

A second window into the interaction of participants with the simulation environment involves analysis of their functions and activities—what they are doing during the calls. The temptation in analyzing this activity is to call upon current evaluation tools that focus on procedural activities. Thus, I initially tried coding interactions to the steps in the patient assessment process. However, as Norman (2005) noted when describing research into the use of clinical reasoning, procedural analysis does not distinguish well between the performance of

novice and expert clinicians. Indeed, from a procedural perspective, first responders, paramedics, and internal medicine diagnosticians follow essentially the same procedure: they form an initial impression, gather data, then, based on their diagnosis, treat the patient.

Two sets of codes emerged to explore what the participants were doing in the simulation environments. The first set reoriented the procedural-based analysis to look at the underlying functions the attendant was performing in a call (see Appendix B, Table B5). The second explored the autonomy with which participants engaged in the calls (see Appendix B, Table B6).

What the attendant is doing. In prior unpublished research at the JIBC, my colleagues and I had isolated three functions that support the procedure of patient assessment: assessment, decision making, and treatment. These became the starting point for analysis of the attendants' actions. These codes evolved to include additional functions including directing, acting under direction, reporting, discussing, and collaborating.

Interestingly, the attendants' functional performance remained relatively constant across the three types of simulations. The primary function of assessment and treatment activities was the predominant function of the attendant in all types of simulations. However, instances of collaboration increased from Core Skills to Classic Case and into the HFS calls. In addition, the HF simulations had substantial amounts of discussion.

These findings further supported Norman's (2005) comments on the challenge of researching the use of procedures. Functionally, the role of the attendant does not change across the simulation types. Indeed, the patient assessment model is taught early in the program explicitly to serve as the procedural framework that guides practice. The increasing use of collaboration and discussion is both reassuring and to be expected as students move into the practicum environment.

What the partners and preceptors are doing. Throughout the coding and analysis process there are often several strands of activity taking place. Yet, curriculum and instructional material and processes focus on the activity of the attendant and treat other participants as peripheral to the call. In this study, coding frameworks that focused on the attendant often needed modification when applied to the partners (drivers) and preceptors. In this section, I look at the activities and interactions of these other participants in the simulation environment.

My initial attempt to code participants' activities and interactions using the patient assessment model did not provide useful distinctions. However, I noticed that there was an underlying intent or varying degrees of autonomy in the actions of the participants. For example, when the attendant was taking a radial pulse, s/he was acting independently as the attendant in charge of the call. However, the attendant often delegated these tasks to the driver or other responders. In several calls, I noticed that when ACP crews arrived, the attendant would suddenly become much more passive, awaiting direction before proceeding. On the other hand, I noted that, while in the Core Skills and Classic Case calls the driver almost always waited for direction, in the HFS calls the driver would often initiate activities in advance or in parallel with the attendant. This analysis led to the development of a set of functional codes (see Table B5) for both attendants and other participants.

These codes highlight the substantial change in role of the partner through the program. In the Core Skills and Classic Case simulations, the partners are explicitly constrained from initiating action or prompting the attendant. In the HF simulations, however, the driver functions as an active partner who performs under direction, independently, and collaboratively.

Figure 15 shows an interaction map for the functions of the driver in a Classic Case call. Simulation vcr_253_03 took place in a breakout room:

The patient sits in a chair in a small classroom. The attendant and driver enter and approach the patient. The attendant performs almost all functions in the call. The driver initially kneels beside the attendant and, when asked, prepares the oxygen tank and places an oxygen mask on the patient (acting under direction). A minute later, the attendant asks the driver to prepare the stretcher. The driver completes this task, then waits for direction again. Together they (collaboratively) move the patient onto the stretcher and verbalize transporting the patient to the ambulance. The driver helps secure equipment, then participates in a short discussion. For the remainder of the call, the attendant functions on her own. The driver literally sits in a chair and watches the rest of the scenario (see Figure 16).

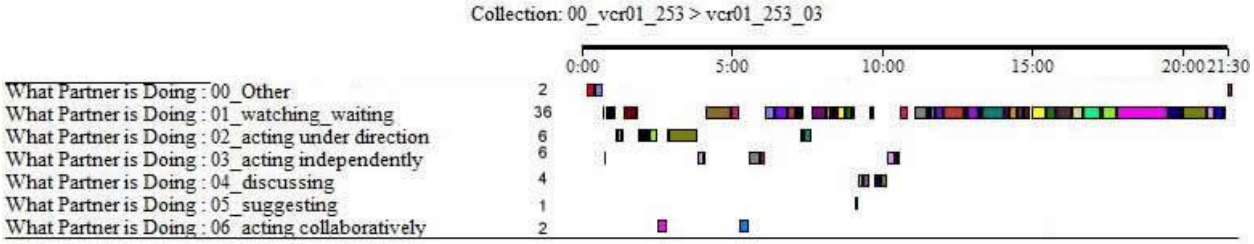

Figure 15. Sample partner function interaction map in Classic Case call. Note the number of segments coded to watching/waiting.

Figure 16. Partner disengaged and watching simulation.

The partners' functions in the HF simulations were quite different, such as in Kelowna, where the partner participated actively.

Description of kel_HFS_06

In this pedestrian struck call, the partner is an active participant (see Figure 17). Her functions alternate between acting under direction, acting collaboratively, and performing independent

actions. The attendant provides direction in the first few minutes of the Primary Survey, but then the partner starts to anticipate and perform tasks independently. She takes vital signs and reports them to the attendant and preceptor. The partner again functions under direction in preparing the backboard and applying a hard collar on the patient. The partner and preceptor then collaborate with the attendant in performing a spinal roll and securing the patient to the backboard and stretcher.

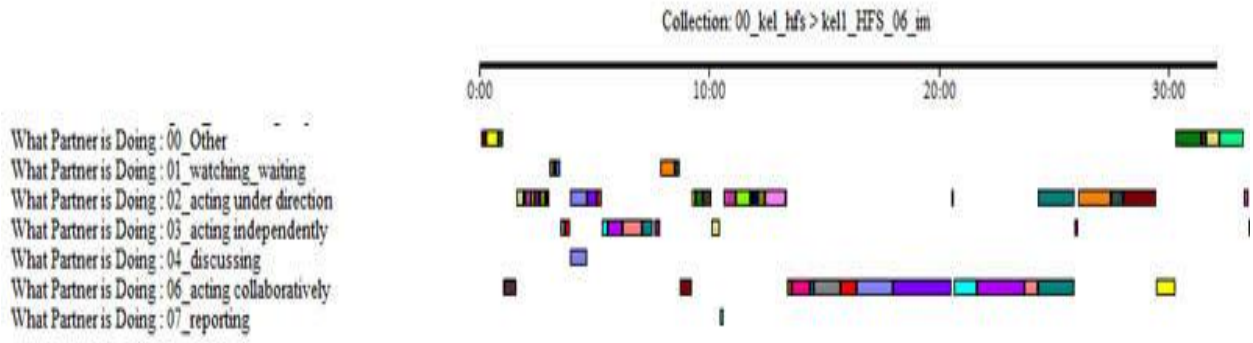

Figure 17. Partner function interaction map for HF simulation: kel_HFS_06. Note that, in contrast to Figure 15, the partner in this call is active throughout the simulation.

Both preceptors and students found the increased role fidelity of the crew members to be useful. One Vancouver preceptor noted that he "liked the way that [the students] started to work together more. As if they were partners. And that's the thing that's always lacking on car." The preceptors gave ongoing feedback to both attendants and partners on what functions the driver should take on a call. In a Kelowna HF simulation (kel_HFS_01), the preceptor coached the driver several times to be more proactive. The driver anticipated his partner's needs and prepared equipment, but then hovered waiting for the attendant to ask for it. The preceptor told the driver to "jump right in there." In the debriefing at the end of the call, this conversation ensued:

Preceptor: And you as the driver, don't wait for her to ask for vitals. . . . 'cause we're not at school. We're at work. We're going to jump right in. We're going to be in there, getting that information. . . . These are important calls and we need every bit of available information, so you want to just rump right in.
PCP2: Yeah, I wasn't—
Preceptor: Talk to each other.
PCP2: I wasn't sure when to step in and do vitals, right?
Preceptor: Which is the point of this, right?

I examined the role of the preceptors in the first section of this chapter. As noted, the preceptors were active participants in the simulations in contrast to the limited role taken by instructors. The preceptors engaged as observers and evaluators, but also as active crew members in the calls. The preceptors provided ongoing coaching and assistance, and even intervened to ensure crew and patient safety. This interaction with the preceptor was evident in analysis of the attendants and partners as increased collaboration and discussion.

In summary, examination of the degree of autonomy in participants' actions shows that the HF simulations allowed for richer and more autonomous activity by all participants in the calls. Increasing the role fidelity of the crew members, and incorporating preceptors rather than instructors, allowed for much richer interaction and participation within the HF simulation environment. The following section further explores the roles and activities of the participants by looking at the fidelity of their actions.

Procedural fidelity. The previous two sections have examined how participants interacted in the simulation environment through the lenses of who they engaged with and the roles and functions they assumed. A third lens explores the fidelity with which they performed those functions—what is termed in this study as procedural fidelity.

I examine two aspects of procedural fidelity: what is used by participants (the object of a procedure or activity) and how it is used (the authenticity of its performance). I explore the strategies participants developed for performing activities in the simulation environment. The objects of procedures are considered through discussions on the use of equipment and the type of patient involved in a simulation.

What is being done: Performing procedures. Imagination and verbalization are important parts of the simulation environment. A simulation is an artificial construct that requires

verbal prompting to locate the activity. A call manager or instructor must set up the call at several levels. The participants must know their overall operational context (e.g., function as a two-person paramedic crew in an urban Canadian setting or function as students with a preceptor in a practicum environment in an urban Canadian setting). Further, the call must be situated in time and place (e.g., 0300 in the rain of late fall outside a residential hotel in a poor district of town). Verbalization may also be used to time-compress selective aspects of the call (such as transportation to hospital). Most commonly, verbalization is used whenever the call manager must provide information that is not immediately available in the environment (e.g., providing abnormal vital signs when the patient is being played by a healthy actor) or when participants must perform an action that they cannot reasonably perform in the simulation environment (such as administering drugs to a colleague who is acting as a patient).

Most simulations, then, are a mix of physical and verbal—actual and imagined—activities. In my analysis, I noticed several patterns of interaction that were essentially verbal but included physical or kinaesthetic components. Table B7 (see Appendix B) lists the codes that emerged to describe the procedural fidelity with which participants performed actions in the simulations. These codes included actual; mirroring, miming, and verbalizing; and practicing.

Mirroring, miming, and verbalizing. Three common forms of activity included mirroring, miming, and verbalizing. As noted above, many procedures were simply verbalized. Other times, participants mirrored an activity—they performed a task and verbalized its results, then got *corrected* information from the call manager. Miming involved physically pretending to complete an activity without actually performing the task.

The following example is taken from the first call in the Kelowna HFS. The student starts the call, but realizes that she does not know how she is supposed to get information.

Excerpt from kel_HFS_01

PCP1: Student in role as attendant
PCP 2: Student in role as driver/partner
Call manager: Instructor who functions as call manager
Patient: Actor in role of patient

An older man is sitting on the stairs of a building. He is pale and sweaty. PCP1 kneels beside him, with her partner standing close by. She reaches out and grasps the man's wrist, then looks up at the call manager, who is out of the shot.

PCP1: Okay, and am I verbalizing that I have a regular pulse? How do I find out what's going on with all that?
Call Manager: Just tell me what you're doing.
PCP1: <Nods and looks back down at the patient. She again takes his wrist in her hand, feeling for a radial pulse.> Okay, regular pulse; breathing's adequate. So what were you doing? You were just going for a walk when this happened?
Patient: Yeah, yeah and I was—
Call manager: <Voice of call manager interrupts the patient's response. The patient looks up over his shoulder towards the call manager. PCP1 also looks up at the call manager.> Pulse was fast and breathing's regular.
PCP1: <Nods, looks back at the patient, then over her shoulder to her partner.> Okay, and get a BP [blood pressure], too.

The attendant used mirroring in this case to get the pulse and breathing findings of the patient. She physically checked the patient's radial pulse and observed his breathing. She verbalized her "actual" findings. The call manager then provided the "real" findings that this patient should be exhibiting. Note that although the call manager tried not to interrupt, his intervention got the attention of all the participants in the video shot, not just the attendant. However, the participants have used this technique throughout their studies and immediately went back into their roles.

Mirroring has two pedagogical functions. Mirroring allows the call manager (or instructor) to assess both what the student is doing and how well she is performing the desired procedure. The student above assessed both pulse and breathing. The pulse check involved an observable behaviour (placing the attendant's fingers on the appropriate location of the patient's

wrist), but the respiration check required only observation by the attendant (looking for rise and fall of the patient's chest). When the attendant verbalized her findings, she was cuing the call manager that she performed both functions. The call manager was able to assess the quality of her actions by considering the findings she related. The call manager could view the patient's breathing and had a good sense of what pulse rate the actor should have had.

Miming emerged as a second form of verbalized behaviour. Miming occurs when a participant goes through the physical motion of performing a procedure while verbalizing the action. Miming occurred in most of the simulations when the participants administered oxygen to the patients. Oxygen masks are not put on the patients in simulations. The masks may restrict someone's breathing if oxygen is not flowing. Since oxygen is not actually administered in the simulations, the students usually either placed the mask beside the patient or hung the mask around the patient's neck.

The preceptor opens the oxygen case, removes a face mask and tubing, and attaches the tubing to the oxygen valve. He hands the mask to the attendant. She tells the patient, "We're going to put some oxygen on you, okay?" then holds the mask up to the patient's face. She mimes putting the mask on the patient's face and placing the strap around the patient's head, then drapes the mask and tubing around the patient's neck to simulate that the mask is in place. (vcr_HFS_19)

Miming also occurred when participants used disposable supplies or performed invasive procedures. For example,

> The PCP crew works on a patient in cardiac arrest. An ACP crew also attends. The PCP participant is directed to start an IV. She pulls out an iodine swab. She mimes tearing the package open and rubs the package on the skin. She starts the IV on the mannequin, but then mimes opening the roller clamp to start the IV running. As the call proceeds, the ACP participant administers several medications. Again, the participant opens the package, but mimes putting the medication and syringe together, mimes inserting the syringe into the IV tubing, and mimes pushing the medication through the syringe. (vcr_HFS_16)

In these instances, the participants go through the physical motions of performing the procedures, but do not actually open packages or use the medications.

A third form of miming occurred when participants verbalized procedures because of physical or physiological limitations of the scenario:

The PCP crew performs a chest pain call. The patient is played by another student who is wearing a paramedic uniform. The attendant uses miming to auscultate the patient's breath sounds. Normally, a paramedic would place the head of the stethoscope under the patient's clothing against the skin to listen for breathing sounds. In this classroom simulation, however, the students and instructors have agreed that they can perform the procedure by placing the stethoscope over the patient's clothing, then verbalize that they are performing the procedure. The call manager then provides the findings. (vcr_253_01)

In vcr_253_6,

The students mime loading the patient into the ambulance and preparing equipment for transport. They move the stretcher up against the wall of the classroom. The attendant asks his partner to "get the oxygen switched to the main tank, get the OPA and BVM out, and, uhm, suction, and we'll head code three to the hospital." The partner uses a mixture of actual and mimed responses. She mimes pulling the oxygen tubing from the portable oxygen tank and putting it onto an imaginary wall mounted oxygen valve. She pulls real oropharyngeal airways and a bag-valve-mask unit from their jump kit, and mimes moving to the front of the mock ambulance to start driving.

Miming serves the same purposes as mirroring—it allows instructors and call managers to know what it is that the participants are doing and allows students to perform functions without actually using medications and other disposable supplies. More important, it allows the participants to perform actions physically that they would otherwise simply verbalize.

In many of the instances of miming, the participant could have simply verbalized the procedure. Yet, the participants seemed more comfortable performing the kinaesthetic actions rather than simply verbalizing the procedure. In kel_HFS_01,

The participants are waiting at the mock hospital. The preceptor uses the waiting time to coach and question the student. She asks, "How would you off load this patient?" The attendant turns to face the patient on the stretcher and says, "Me? I would use blankets. Lower and then, just roll him across." As she says this, she mimes pulling the sheets from the stretcher and makes a pulling motion towards herself, as though pulling the patient onto an imaginary bed. "Okay, great," replies the preceptor. The student's response to the verbal question is both verbal and physical. It is as if the answer is a physical response rather than declarative knowledge. And the use of miming in the simulations seems to be a form of imprinting or reinforcing this more kinaesthetic way of knowing.

Practicing. Another form of activity was coded as practicing, a function that occurred primarily in the Core Skills drills and simulations. At times, the participants appeared to be performing actions while rehearsing from a mental script. Thus, in a chest pain simulation from the Core Skills sessions, the attendant asked a series of patterned questions but was not really paying attention to the patient's responses. He appeared to be going through the steps in a procedural fashion, practicing asking the questions. He was aware of the patient's responses but did not appear to react to the information he received.

Performing "on." Procedural fidelity is also dependent on interaction with the physical environment. This section explores two facets of the simulation environment: the equipment and the patient.

The simulations in this study used actual ambulance equipment for most activities. There were a few notable exceptions, such as monitor-defibrillators which, in a simulation setting, are specially designed training devices. Learners practiced using disposable material, such as dressings, medications, alcohol swipes, and bandages in skill stations, but later used these items in a miming fashion. Students would, for example, pull out a package of sterile dressings, then mime opening the package and placing the dressings on the patient's injury. Thus, the equipment could be used multiple times. Other single-use equipment, such as oropharyngeal airways, oxygen masks, and moldable splints, were repackaged and used in multiple simulations.

Thus, throughout the program, students used actual equipment in the manner in which they would use it in the field. The procedural fidelity for equipment use in all the simulations in this study was very high.

The second aspect of the physical environment that affects procedural fidelity is the patient. Most equipment was used with or on a patient. The monitor was used to observe a

patient's ECG rhythm. Dressings were placed on a patient's wounds. A blood pressure cuff assessed the patient's blood pressure. Lifting devices allowed the crew to move the patient from the floor to the stretcher. Thus, procedural fidelity included both assessment procedures (ECG, blood pressure, etc.) and treatment (hemorrhage control, lifting and transferring). The patients in this study were represented by a mix of human patient simulators (task trainers and mannequins) and actors.

Task trainers are devices that allow simulation of a particular procedure or group of procedures. An IV arm is a plastic representation of a forearm that allows students to practice starting intravenous lines and administering medications. Task trainers are generally used in skill stations to practice and internalize specific procedures. IV arms are also used in some Classic Case simulations along with an actor. The actor plays the role of the patient, but the task trainer is used when the attendant wishes to initiate an IV and give IV medication.

A HF mannequin was used in several HF simulations where the call required advanced procedures (e.g., intubation, defibrillation, IV) or where the patient presented with abnormal vital signs, such as vcr_HFS_18, where a mannequin was used as a semiconscious elderly male with failing vital signs. Patients were played in most of the simulations in this study by actors. In the CC220 and Classic Case simulations, students played the part of the patient.

Procedural fidelity findings. Literature on medical simulation has implied that the use of HF mannequins is necessary to perform procedures in an authentic manner (Beaubien & Baker, 2004). One of the interesting findings in this study was that procedural fidelity at the simulation level was relatively high in all forms of simulation.

Figure 18 shows the coding of the attendant's interactions for a Core Skills, Classic Case, and two HF simulations. The boxed areas highlight verbalizing or mimicking activities. Not

surprisingly, the number of non-actual actions decreases as the students move from a classroom to a HF environment. What is interesting, however, is that, even in the classroom environment, which is considered low fidelity, the majority of interactions in the simulation have high procedural fidelity.

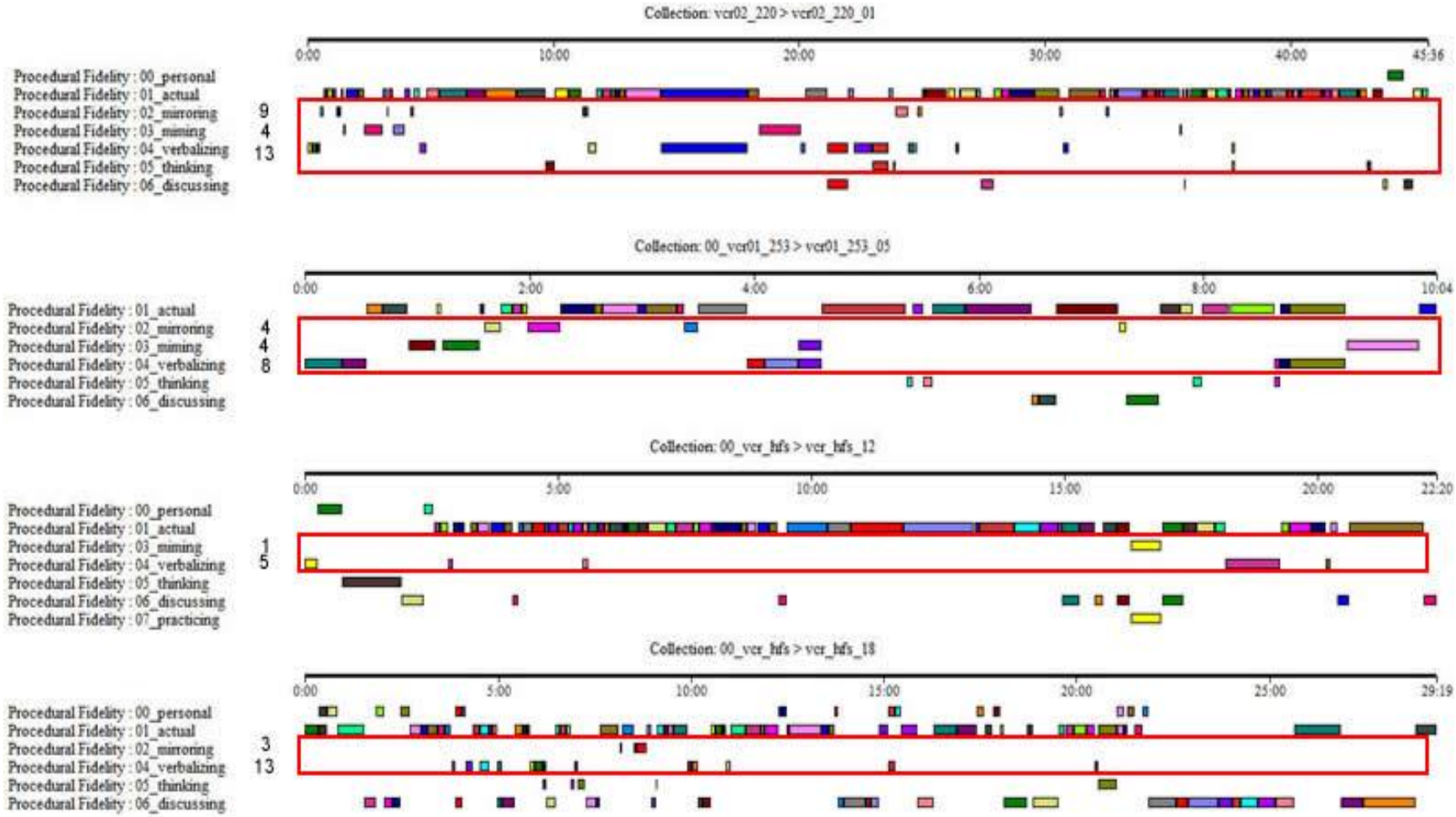

Figure 18. Contrasting procedural fidelity in CS220, CC253, and two HF simulations.

Boxed area indicates activities that are performed in some form of verbal or mimed activity.

The goal of the Core Skills simulation is to practice and integrate procedures within the context of an ambulance experience, and this goal is met even with limited fidelity of specific aspects of the simulation. In vcr02_220_01,

a student is playing the role of the patient. Thus, most of the assessment findings are provided as verbal information from the call manager. The miming and mirroring actions represent instances of the attendant performing an assessment activity (such as taking a blood pressure) and receiving the real (from the scenario's perspective) information as verbal information. The participants must verbalize and imagine mental operations (such as assessing the scene for hazards or mechanism of injury or observing the patient's skin colour and condition) and time-compressed functions such as moving the patient to an ambulance and transporting to hospital. Yet, the overwhelming majority of activities performed by the attendant in this call are performed in an authentic manner. The key functions of assessing the limb and applying the Sager splint are performed in full.

Thus, even in a simulation with low physiological, role, and interpersonal fidelity, the students practiced specific procedures, such as assessing and splinting a lower limb fracture, authentically and within a realistic overall procedural experience. While the overall procedural fidelity of the simulations in this study was higher in the HF environment, the classroom simulations still provided an effective environment for meeting the desired learning goals.

Blends of procedural fidelity. While simulation environments are often characterized as low fidelity (e.g., use of task trainers) or high fidelity (use of HF mannequins), I found that the simulations in this study included an intriguing blend differing aspects of procedural fidelity.

In vcr_HFS_18,

the patient is represented by a HF mannequin. The attendant struggles several times during the call, unsure of how to interact with the mannequin. The students had not worked with this type of HF mannequin before. The student is surprised when the mannequin speaks to her.[16] Only one arm of the mannequin is set up with pulses. The attendant is initially unable to find pulses because she was checking the "wrong" arm. The attendant and partner also struggle when transferring the mannequin from the bed to their stretcher. The mannequin is more rigid than a live person and, although lighter than a person, is considerably more awkward to transfer. The

[16] This style of mannequin had an integrated wireless radio and speaker system so that a call manager could "speak" as the patient. Although the feature was available in class, the instructors had not previously used it.

students are also unfamiliar with the hoses and electrical cords on this style of mannequin. Thus, the attendant has a number of verbal exchanges with the call manager throughout this call.[17]

While the use of the HF mannequin allows for higher physiological fidelity, this fidelity is only realized when the student knows which side of the mannequin to approach and assess. Accessing the affordances of the mannequin also comes with limitations in other aspects, such as weight, flexibility, and mobility of the mannequin in comparison to a live patient.

Medical education programs have effectively used actors as standardized patients for several decades (Howley, Szauter, Perkowski, Clifton, & McNaughton, 2008). The actors provide rich interpersonal interaction and, when properly coached, extensive histories. However, the use of actors limits other aspects of fidelity. A number of HF simulations use actors portraying patients with shortness of breath or chest pain. The actors portray their parts convincingly, creating situations with high anxiety (profoundly short of breath woman in the atrium of the JIBC), angst (man with an aortic aneurysm whose history completely stumped the attendant), and a bit of exasperation (woman with dizziness and vertigo). What the actors cannot portray is abnormal vital signs such as rapid or irregular heartbeats or high blood pressure. In these cases, a call manager intervenes with mirroring techniques. Thus, the sense of continuity and engagement with the moment created by ongoing interpersonal interaction is broken whenever a call manager intervenes to provide verbal information such as vital signs.

In each case, the procedural fidelity of the scenario is mixed. The participants can take vital signs and obtain ECG tracings from the mannequins and perform advanced and invasive procedures such as intubation or IV initiation. However, this comes at a cost of knowing how the mannequins function and reduced interpersonal fidelity. Actors allow richer forms of

[17] See Figure 18 for call vcr_hfs_18. Note the number of instances where the attendant is “discussing” throughout the simulation.

interpersonal reaction and interaction, but require participants to verbalize aspects of their care.

Procedural fidelity summary. Several interesting findings emerged from looking at the procedural fidelity of the simulations in this study. Although fidelity is often framed as a unitary concept, the procedural fidelity in this study varied from simulation to simulation. While there are obvious trends, it is difficult to speak about *the* fidelity—or even *the* procedural fidelity—in these experiences. The procedural fidelity of all simulations was generally quite high, particularly when considered as whole experiences. Yet, specific activities in every simulation involved some form(s) of verbalized or imaginary action. Even the simulations in Core Skills consisted mostly of authentic tasks performed using actual equipment and procedures. In general, the procedural fidelity was higher in the HF simulations, although both the number and type of non-authentic tasks varied from call to call. The participants used several strategies to mimic real procedures, including mirroring and miming. These strategies cued both partners and call managers as to what the participants were doing. The participants also used these strategies to practice and reinforce the performance of tasks within the context of overall performance of the call.

Participant Interaction and Function Summary

The HF simulations in this study enhanced the physiological fidelity, role fidelity, and interpersonal fidelity by including actors as patients, bystanders, family, and other responders. The result was a dynamic environment. As noted in a previous section, the preceptors actively engaged with and encouraged the students to interact with the various elements of the environment. The students required ongoing prompting to engage with other responders and to begin assuming their new roles. The students used a variety of strategies to practice and perform tasks in the simulation environments. Although the overall procedural fidelity of HF simulations

was greater than classroom simulations, most functions in most simulations were completed in an authentic manner.

How Do Participants Engage With Simulation Environments?

Practice learning environments—simulations—are contrived spaces which present, in either actual or simulated fashion, selected aspects of a field encounter for participants to experience. Actors and HF mannequins allow for more authentic interaction and assessment, reducing the need for the call managers to interrupt and provide verbal information throughout the activity. Indeed, the intent of these enhancements is to reduce the visibility of the simulated aspects of the situation and allow participants to become immersed in the experience.

This section explores selected facets of how participants engaged with the HFS environments created in this study. Specifically, I look at how immersed the participants appeared to be in the simulations, what they attended to and where they obtained information, how they structured and reported their experiences, and how they conceived of and interacted with patient and problem. I used an iterative and inductive process of observation (of video) and coding to examine participants' engagement in the moment and explore the intriguing ways they engaged with patients as conceptual entities, instances of an injury or condition, and as a person with a rich health, social, and cultural history. I explore the variable use of the environment by participants for gathering information through the creation of information maps that described from whom and what they gathered data. I call upon descriptive statistics and narrative analysis techniques to identify patterns in the way participants structured and reported their experiences and evidence of their use of clinical reasoning strategies.

Immersion or Cognitive Focus

Immersion, or cognitive focus, was not in the original set of codes that I developed for

this study. As I worked with the initial codes, however, I noticed a recurrent phenomenon—instances in which one or more of the participants would visibly disengage or pop out of the simulation for a few moments or minutes. These instances are reminiscent of when actors in a movie or play "break the fourth wall" and look or speak directly to the camera or audience. The participants in much of a simulation seemed to be totally engaged in a real call, while, at other times, they seemed to know that they were acting in a simulation. The students and preceptors occasionally disengaged with the simulation to have a discussion over top of the call, talking about some aspect of patient care or paramedic practice in general. The participants, at different times, appeared to be cognitively *in a call*, *in a sim[ulation]*, *in the day*, or *taking a course*.

The resulting codes represent an overlapping set of constructs that try to address the question, "Where (cognitively) is the participant?" Table B8 (see Appendix B) outlines the coding categories for cognitive focus (immersion). Codes emerged to indicate when participants were engaged with the *concept of the call*, non-simulation activities, in the *call*, *in the sim*, *in the day, or in the career.*

Findings and discussion. My expectation was that the apparent immersion of the participants should increase as the fidelity of the simulation increased. And, in general, the participants in the HF simulations spent far more time *in the call* than participants in the Core Skills and Classic Case simulations (see, for example, Figure 19). However, the interaction maps of specific calls varied significantly, both in terms of how much time and when in the call the participants were *in the call* and *in the sim* (see Figure 20).

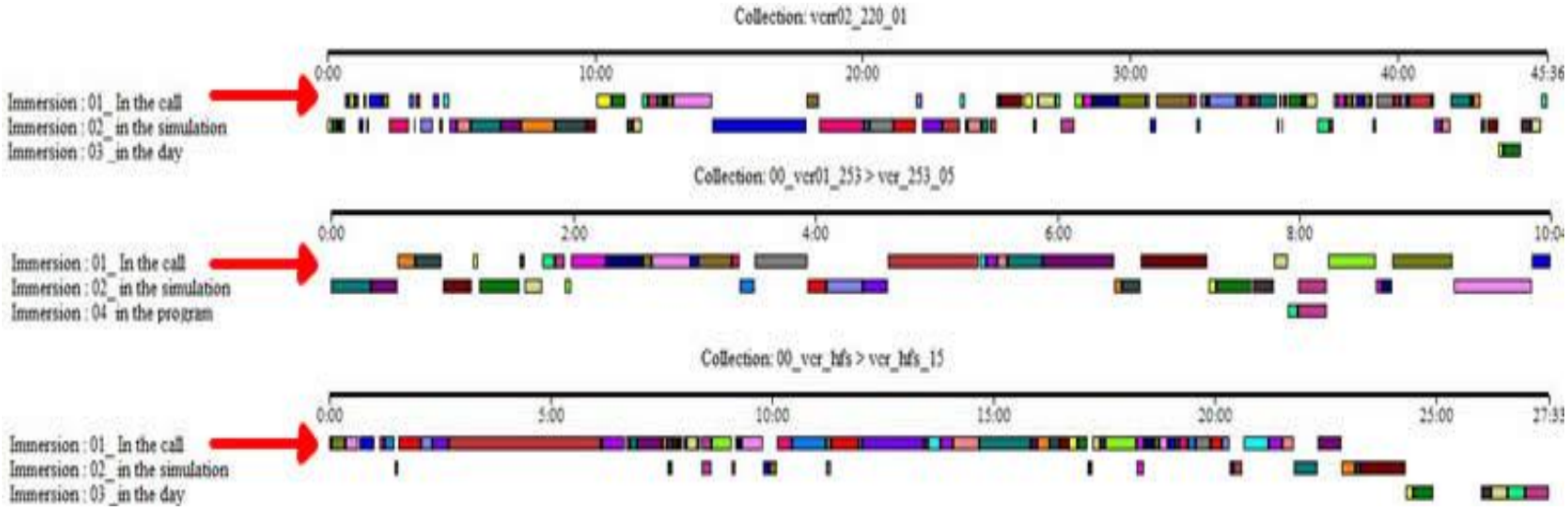

Figure 19. Comparison of cognitive focus of attendants in sample Core Skills, Classic Case, and HF simulations.

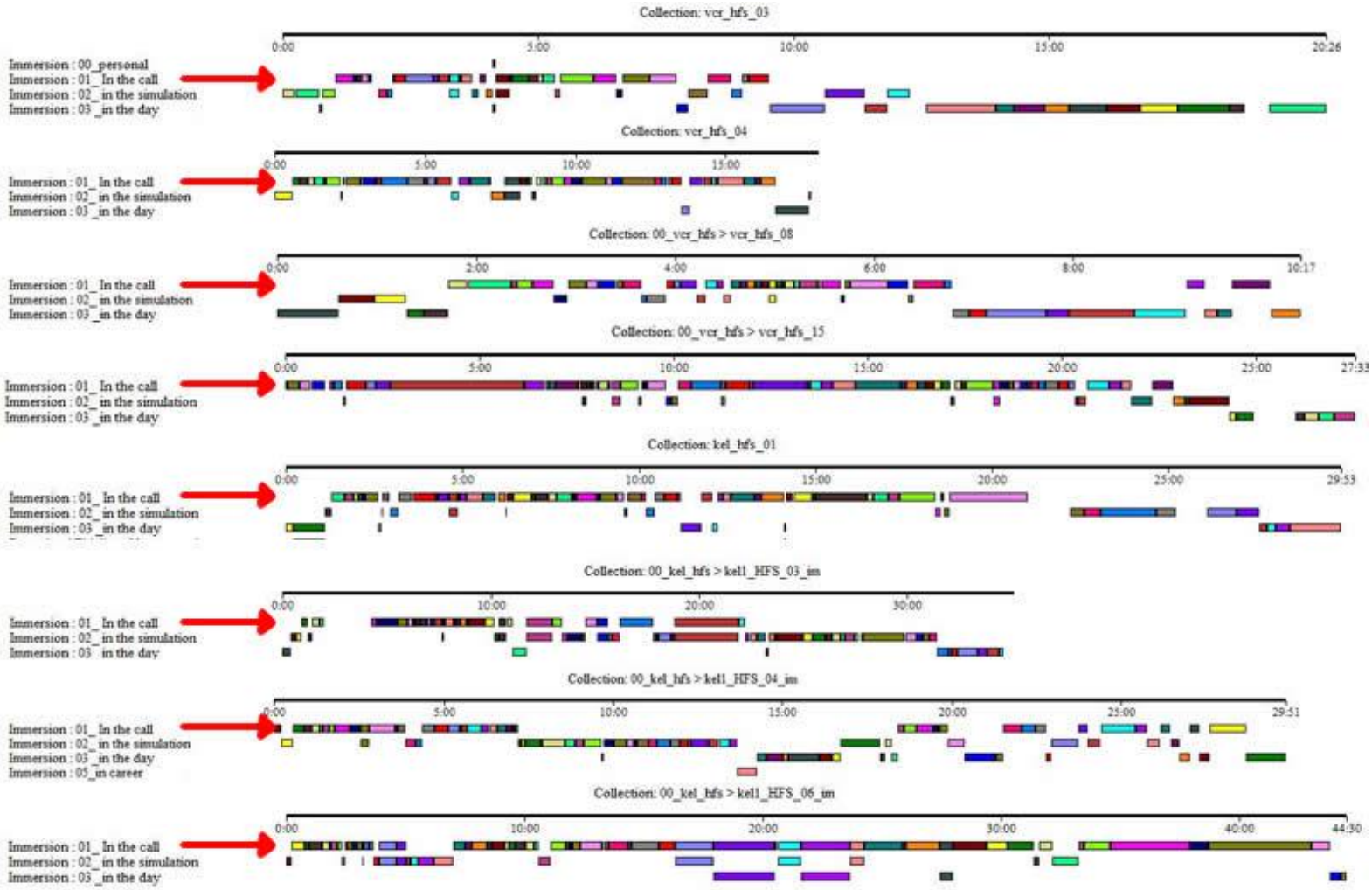

Figure 20. Cognitive focus of selected high fidelity simulations

In general, the participants in the HF simulations tended to remain *in the call* whenever they were actively engaged with the patient. Periods of time *in the sim* occurred during transit times (when the crew was going to the scene or from the scene to the hospital) or instances where lower fidelity of some aspect of the call required the participants to verbalize an action or ask for information that was not available from the scene (such as an actor's breath sounds).

Figure 21 displays the interaction map for a Vancouver HF simulation (vcr_HFS_08):

The participants start *in the day*. The attendant looks at the camera, smiles, and recites the call location, dispatch information, and the names of the participants. The crew remain *in the sim* while they discuss with the preceptor what type of equipment to bring. The next clip moves *in the call* as the crew approaches and sees police at the scene. They remain engaged in the call as they meet and obtain a brief history of the incident from the police and bystander. They are reminded that they are in a simulation when the call manager intervenes to expand on what the bystander had said. The attendant acknowledges the call manager's comments then appears to reengage with the call as she kneels down and addresses the patient. She starts her initial assessment by talking to the patient and checking his level of consciousness. Again, the call manager intervenes to prompt the actor to do "as he's told [and] open his eyes." The PCP looks back and forth between the patient and the call manager, apparently unsure whether to assess the patient or ask the call manager for information. "Does he—like does he have like anything—it's just as I find it, right? Okay." She confirms with the call manager that she should continue to assess the patient and that the findings will be "just as I find it."

The crew remain *in the call* for most of this simulation, although engaging *in the sim* when the call manager provides prompts or additional information. Later in this call, the patient gets up and walks away from the scene, saying that he is just looking for a place to rest. The crew and police agree that there is no reason to detain him. The crew then tidies up their equipment and begins a discussion/debrief at about 7 minutes into the call. From this point on the crew is no longer *in the call* nor *in the sim*. Rather, as they continue their debriefing session, they move into *the day*, where they are no longer engaged in the simulation at all.

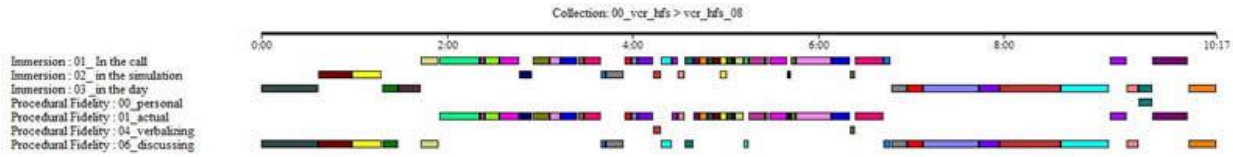

Figure 21. Cognitive focus and procedural fidelity in vcr_HFS_08.

Similar patterns were found in all of the HF simulations. The participants often started the call with some discussion either focused on the mechanics of the simulation or the structure

of the day. Thus, the immersion in the first few minutes of many simulations was mixed. Because the participants have to respond to different locations, this period was variable. However, once they arrived at their patients' side, the participants usually remained *in the call* with occasional segments where the attendants reacted *in the sim.* These instances were usually associated with periods where the physiological or procedural fidelity dropped and the participant either obtained information verbally or—in some fashion—mimicked or verbalized a procedure (e.g., obtaining a blood pressure reading on an actor or administering a medication). The participants were often less engaged during transport times or when they were in the mock hospital, waiting to give report to the triage nurse. These periods were usually either *in the sim* as the crews discussed some aspect of the experience, or *in the day* if the discussion moved to broader topics.

Popping out. I initially became interested in the immersion of the calls by noticing instances where one or more participants would *pop out* of the call. Popping out was distinguished from a movement between being *in the call* and *in the sim* by the sudden, obvious shift in the participant's attention and focus. The participant literally stuttered or physically changed position, and awareness moved from the other participants or environment to literally looking up and outward, often to the call manager or camera operator.

Table 14 identifies instances in which the participants cognitively disengaged from participation in the simulations. Thirty percent of these instances involved situations where there was uncertainty or a flaw in the physical or physiological fidelity of a patient's presentation. Another 37% were instances of a participant seeking information or clarification on an assessment finding, and discussions on the mechanics of performing a simulation.

Table 14. Coding categories for instances when participants "pop out" or cognitively disengage from simulation

Code	Definition	Instances	% of Instances
Fidelity—flaws in physical or physiological fidelity	Flow of the call is interrupted due to a problem with the physical or physiological fidelity of some aspect of the call. Note that these are instances in which dealing with the flaw in fidelity interrupts performance. This does not include instances in which the participants mirror or mimic a procedure without stopping in the middle of the call.	14	19%
Mannequin/fidelity issues	Flow of the call is interrupted due to some aspect of using a high fidelity mannequin (e.g., Call manager informing attendant that she can only take blood pressures on the mannequin's left arm).	8	11%
Seeking confirmation/ validation	Instances in which a participant disengages from the flow of the simulation and speaks directly to Call Manager (or other simulation participant) to seek information that is not available in the environment (e.g., actor's blood pressure or blood glucose reading) or to confirm or seek further information regarding something they have seen/done in the call (e.g., asking if a moulage injury represents a fractured bone).	13	18%
Simulation mechanics	Participant disengages from flow of call to ask or discuss some aspect of the simulation (e.g., asking Call Manager whether to use actor's real vital signs or if the Call Manager will provide information).	14	19%
Call manager intervenes	Call manager intervenes to provide information to the participants. Note that these are instances in which the Call Manager initiates discussion to prompt participants or influence unfolding of simulation. Does not include instances in which the participants initiate conversation with the Call manager.	7	9%
Preceptor intervenes	Preceptor initiates discussion or action that interrupts other participants or diverts their attention to functional aspects of the simulation or to non-call related topics.	4	5%
Recognize own error	Participant disengages from flow of call and verbalizes/recognizes that she/he has made and error.	2	3%
Reference to simulation day/course	Participant disengages from ongoing flow of call to discuss some aspect of the simulation day or the course/program (e.g., talking to an actor about something that happened on a previous call).	12	16%
Recognize actor from previous simulation	Participant recognizes or greets actor or participant from a previous simulation (e.g., walking up to patient who is a fellow student and saying to her partner: "Remember, that's not Jeff.")	5	7%
Aporias	Moments of sudden disengagement associated with puzzlement or uncertainty.	5	7%
Other		7	9%

In a Vancouver HF simulation, vcr_HFS_09,

An attendant sees the blood on a patient's pant and appears momentarily flustered when she puts her hands on the injury site (to control bleeding) and the patient yells. "Is it broken?" she asks the patient, seeking verbal confirmation of the nature of the injury from him. "I don't know, I think so!" he replies, staying in character. She also *pops out* when she is unsure of the mechanics of the simulation—she doesn't know if she can cut the actor's clothing. She looks up to the call manager and asks, "Can I cut that?"

The immersion of the experience also changed when either call managers or preceptors intervened to redirect or prompt students. In vcr_HFS_08, the call manager intervened several times to prompt bystanders with additional history or to explain to the attendant that the patient smelled of bad cologne but not alcohol. Other instances involved times when the participants referenced events outside the simulation, such as recognizing an actor from a previous scenario or joking with the actors.

The final category involved aporias, or moments of confusion, when a participant would suddenly and literally come to a stop when confronted with something she or he did not understand. The participant would appear to consider things for a few moments, trying to decide what to do next. In some instances, the participant would turn to a call manager or preceptor for guidance. In others, the participant would make a decision and either verbalize the next step or reengage with the call. The majority of these instances occurred when a participant encountered a flaw in the fidelity of the simulation, such as the attendant who was surprised when the mannequin began moaning.

Cognitive focus discussion. The participants generally functioned quite comfortably in the HF environment. For the majority of the time, they were engaged in the calls, interacting easily with each other, the actors, and the physical environment. At times, they had to perform some procedure or interact in a non-authentic manner, such as when they had to verbalize drug administration or obtain specific vital signs from the call manager. However, the participants usually moved from *in the call* to *in the sim* seamlessly. They seemed to blend these experiences into a whole. The Core Skills and Classic Case simulations also flowed quite well, although more of the call occured *in the sim*, and both the patients and the partners in these calls were often less active and less engaged in the moment.

There were, however, times when the participants did disengage with the simulation. Intervention by the call managers or preceptors occasionally took the participants out of the moment. At other times, flaws in fidelity or moments of uncertainty about how to interpret something in the situation caused the participants to pop out momentarily. Again, in most instances, they resolved the moment and then slipped back into being immersed in the calls.

Horizons. The simulation environment can be conceived of as a series of nested elements or constructs. At its centre is the injury or condition that precipitated the patient's call for help. The condition manifests itself through the patient, who has both a health history and a life history. The patient presents within both an immediate and broader physical environment, which are populated by family and bystanders, themselves constituting and contributing to larger social and cultural aspects of the incident. The experiences and actions of the attendant partner, and preceptor, along with other responders, intersect with those of the patient and bystanders. In this section, I examine the horizon of the participants: How much of the simulation environment they engaged with and where they obtained information for their decision making.

Figure 22 shows an interaction map for a Kelowna HFS that presents the interactions of the attendant up until arrival of the crew at the hospital. The primary focus of the attendant was on the patient, the use of equipment, her partner, and the preceptor. There were few interactions with bystanders or the environment. This pattern was repeated throughout the HF simulations. While the participants did engage with the enhanced elements of the simulation, these interactions were generally sparse and usually at the beginning of the scenario as the crew first approached the patient. Exceptions included scenarios in which the other bystanders or family were an active part of the simulation (such as vcr_HFS_18, where the family continues to argue amongst themselves about whether to send their father to the hospital, shown in Figure 23).

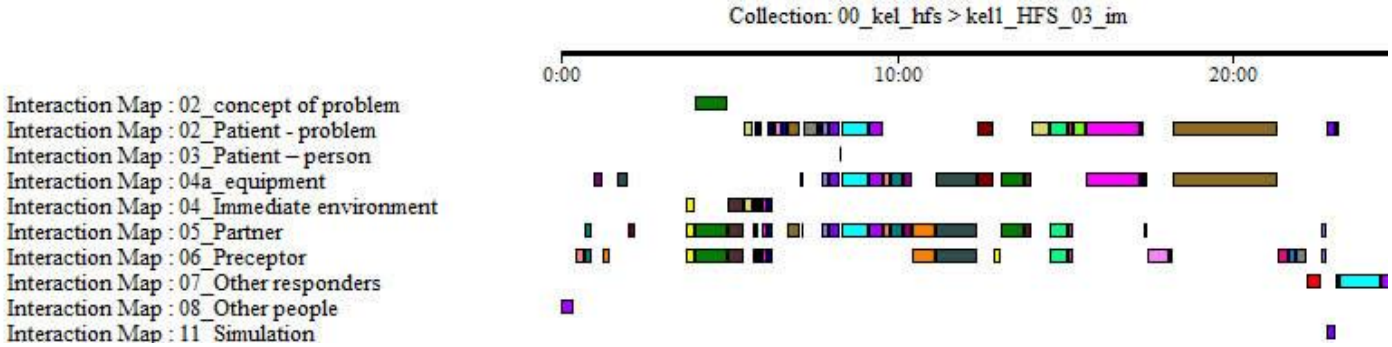

Figure 22. Interaction map for attendant of kel_HFS_03.

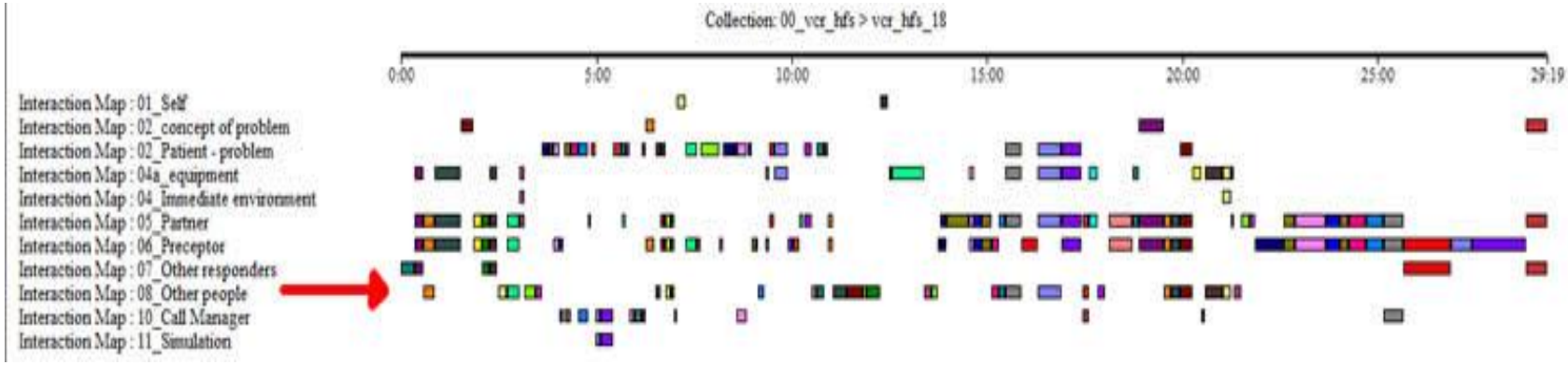

Figure 23. Interaction map of attendant for vcr_HFS_18 showing broad engagement with personnel and physical features of the simulation environment.

I then investigated to see if I could determine how much of the information that was available was obtained by the attendants. I created information maps for selected simulations to investigate the extent to which the participants gathered information from the various elements in the environment—to see what the participants' horizon was.

The patient assessment model (PAM) is the procedural framework for an ambulance call and serves as the organizing frame for the information maps (see Figure 24). The horizontal axis is organized using the phases of the PAM. The top axis of the map is organized from abstract (verbal sources, such as the call manager) to concrete (physically from the sources closest to the problem, such as the patient to those farthest such as the broader environment). The left side of the map shows the primary source of available information. The right side of the map shows where the participants actually obtained that information from. The numbers on the right side represent the order that actions were taken. The information sources are mirrored from the central axis, so the call manager is closest to the centre for both sides of the map and the broader environment is farthest from the centre for both sides of the map. Ideally, if the students are gathering information that is available in the scenario, the two sides of the map should mirror each other. The highlighted boxes in Figure 24 show items of interest where the student missed opportunities to obtain data from elements of the simulation environment.

Call	Broader Env	Preceptor	Partner	Other Responders	Bystanders	Immed Env	Pt - Int	Pt - S/S	Verbal Pt	Verbal CM	N/A	Step	Verbalize CM	Pt - Verbalize	Pt - visual	Pt - physical	Pt - Talk Ta	Immed Env	Bystanders	Other Responders	Partner	Preceptor	Broader Env
Scene						X						Safety						1					
					X							MOI							2				
					X							Approach											
Primary								X				LOC					3						
											X	D											
								X				A				4							
								X				B	5										
								X			X	C	6			6							
								X				RBS				7							
										X		Skin	8										
										X		SPO2											
												Other											
												Rearrers											
History					X							C/C							X				
					X							Hx C/C							X				
					X							PMHx							X				
					X							Medications							X				
					X							Allergies							X				
											X	Pain Complaint											
					X							Functional Inquiry											
												Other											
Physical Exam								X				Head/Neck											
								X				Thorax											
								X				Breath Sounds											
								X				Hips/Pelvis											
								X				Upper Ext											
								X				Lower Ext											
												Other											
Vital Signs								X	X			LOC				X	X						
								X				Pulse				X							
								X				Resp				X							
								X				BP	X										
										X		Skin	X										
								X				Pupils				X							
										X		Blood Glucose											
												Other VS											
Other											X	Health											
											X	Personal											
											X	Social											
											X	Cultural											

Figure 24. Information sources for vcr_HFS_18. Highlighting indicates instances where student did not obtain information available in from other participants or elements of the simulation environment.

Horizons findings and discussion. The information maps both supported and challenged my initial assumptions. I had expected that the participants would engage more fully with a richer environment. However, the information maps showed that participants' horizon was primarily focused on the patient's problem, the equipment, and their interactions with each other. Both the information maps and the interaction maps showed that the participants did, indeed, engage with the environment and with the other participants. However, that participation tended to be somewhat shallow.

The Vancouver HF simulation (vcr_HFS_18) involved a call for an elderly male with long-term care needs living at home. His condition has recently deteriorated and his three adult children and their spouses conduct an ongoing argument about whether they should care for the patient at home or move him to hospital. The interaction map for this call (see Figure 25) shows ongoing interactions with other people—the family of the patient, in this case. The information map (see Figure 24), in contrast, explores what *types* of interactions occurred. The information map indicates that the crew interacted with the family during the initial approach to the scene and to obtain the patient's medical history. However, there were no interactions with the family that explored the patient's health history, life history, or social or cultural situation. Yet the family dynamics and their apparent inability to cope with their father's condition were a key element of this encounter. The crew interacted with the family throughout the call but saw them as a distraction (see section on Interaction, above) and did not record or pass on the obvious social concerns to the hospital and medical staff (see Reports below).

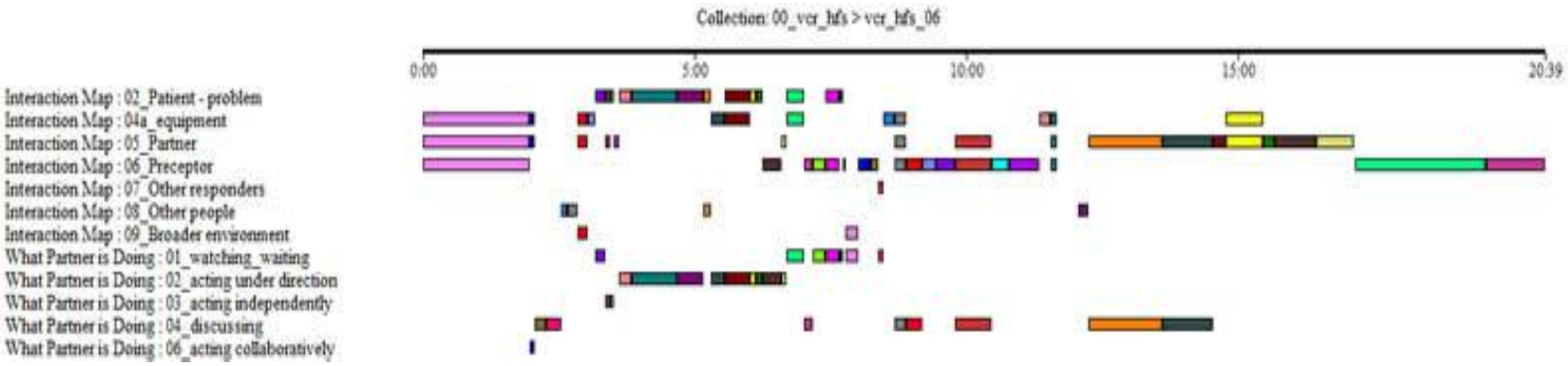

Figure 25. Sample interaction map showing predominance of interactions with preceptors and partners.

All the HF simulation information maps showed a similar pattern of interaction with the bystanders and environment on approach to the call but limited interaction during patient assessment. Few of the calls showed any interaction with the family or bystanders, even on calls in which social and interpersonal issues were embedded. None of the crews involved in the four domestic dispute calls explored the social setting or passed on concerns or information to the hospital staff. The Kelowna triage nurse (who was an ER nurse) did ask follow-up questions of many crews in the Kelowna simulations. In these instances, the crews were able to answer questions, but they did not initially offer this information, nor did they expand on their answers to the triage nurse. Thus, the students seemed to be aware of the social and interpersonal factors, but they simply were not processing the information and bringing it into their decision making.

Tendency to verbal information. The participants' limited horizon or incorporation of the richer environment was also indicated by a tendency to look to verbal sources of information that were physically available in the scenario. This tendency took two forms: directly asking for information rather than looking for it in the environment and mirroring/seeking for validation or elaboration on findings from the environment.

In several calls, participants would start assessing the scene or the patient and then would verbally ask for information that was available from the environment. For example, in a Vancouver HF simulation (vcr_HFS_03),

a young man has been hit by a van. He is sitting on the ground near the van. As the crew approach, they see his legs extended in front of him. His right foot is obviously everted (turned outwards) and there is a significant amount of blood near the bottom of his right pant leg. He is in obvious pain.

The attendant observes the blood on the patient's leg and assumes that there is a significant injury there. She kneels down and immediately puts pressure on the moulaged wound even though she has not exposed or checked the injury. When the patient complains that it hurts, she slips out of character and looks at the patient to ask him if the leg is broken. The patient remains in character but does answer her question. This is normal practice in the classroom simulations where the patients do not have moulage or make up. The students would normally ask for the

information verbally. They then mime and/or verbally indicate that they are cutting and exposing the injury to assess it and then intervene. Yet, in this call, there is an obvious visual indicator (blood on the pants). The student does not expose or examine the injury, but simply puts her hands on it. When the patient tries to prompt her by yelling and saying it hurts, she defaults to asking for a verbal description of the injury.

The participants did make increasing use of the physical environment as they worked in it. However, they remained prone to verbally checking for information about the calls. The rules for the day were to use mirroring when assessing actors. Crews would take the vital signs of actors, and call managers would intervene if the participants should have an abnormal finding. In a number of instances, the participants sought validation of their findings by asking the patient or call manager to confirm what they were finding.

Performing the steps of patient assessment. The students generally followed the PAM in conducting their simulations. There were few instances in which the preceptors had to intervene to keep the students organized and on track. In those instances, the preceptors would remind or prompt the students to follow the PAM.

More commonly, however, the students would perform the steps of the PAM, but in a rote and somewhat limited fashion. In several calls, the students would walk into calls and go through the steps of their assessment, but miss significant issues or misinterpret their findings. Two versions of a call involving non-cardiac chest pain were run in Kelowna. In one version, the attending crew treated it as a cardiac chest pain, administered ASA, and—in the debrief—informed the preceptor that if the patient had had a prescription for nitroglycerin, the attendant would have administered it. Yet, in the call, the pain does not present as cardiac chest pain and thus, the student should not be treating it as such. In the other instance, the attendant is not sure what the cause of the chest pain is and does not treat it as cardiac, but says that he could not rule out cardiac causes.

The attendants in all four domestic dispute calls focused in on the first or most obvious

patient, but did not consider the spouses in the calls as potential patients and never assessed them—even when the attendants saw obvious injuries on the spouses when they talked to them. A Vancouver cohort crew attended a multi-trauma patient, when a motor vehicle accident is staged about 30 meters away. The crew looked up initially but returned to their call. When a bystander approached saying someone needed help at the other accident site, one member asked the police to control the bystanders.

In each of these cases, the students were performing their call appropriately. They were gathering the information they should and were taking all required assessment steps. However, they each missed or misinterpreted critical information. They either did not consider that the patient's chest pain could be non-cardiac, assumed that cardiac arrest was a medical call, were satisfied that they had the appropriate patient, or did not choose to engage with another incident.

This focus on procedure over outcome (performing the steps of assessment without processing the information adequately) was further highlighted by the feedback from the preceptors. As noted in the section on the preceptors' feedback, several preceptors worked with their students to go deeper in their history taking and to use the clinical reasoning model.

In a Kelowna HF simulation involving a non-cardiac chest pain patient, both the call manager and the preceptor spent time after the call talking the students through the clinical reasoning process:

Instructor: Yeah, well . . . how good were the friends?
PCP1: How good were the friends? Well, when I asked them, they didn't know much other than he's been painting.
Instructor: Did you jump into that a little bit?
PCP1: No. But I should have.
Instructor: Did you watch how he described the pain?
PCP1: From here up to here?
Instructor: Ever seen that before?
PCP1: No.

Preceptor: That's why I was asking about . . . you know . . . When was the pain . . . how long has he had it? What increases it? What makes it worse? So if you follow that system of what makes it better? What makes it worse? What brings it on? How long does it last? Is the short of breath come with it or does the pain come on its own?
Instructor: Did he ever say he had chest pain?
PCP1: No—he just said that it radiated into here.
Instructor: Actually, it radiated?
PCP1: Yeah.
PCP1: Then with the history, so I did tunnel vision, like you said.
Preceptor: And I was going to ask you if there was a protocol that should be done—
PCP1: No, that was good.
Preceptor: 'Cause I need to know what you're thinking. You weighed on the side of doing preventative care. Okay, in case it was cardiac. That's why I allowed you to give the ASA. Okay, cause he had no . . . would you have given this gentleman—if he had nitroglycerin, would you have given him nitro spray for this?
PCP1: Uhm, you know, going through, I would have in the call, to be honest. But now, probably not. I would have investigated his angina—if it was similar. If it wasn't, then go that way.

The preceptor prompted the student not just to ask her standard questions, but to follow up and explore the patient's pain complaint. In a subsequent call with the same crew, the preceptor was dissatisfied when the attendant asked questions that allowed the patient to describe the pain, but did not ask questions to try to determine the cause of the pain. She intervened several times, giving the student questions to ask the patient. Finally, she stopped the attendant and told him, "You have to start ruling things out, here." The student is using his history-taking as a set of questions to be asked, not as a process for determining the underlying problem.

In the Vancouver cohort debrief after the simulation day, the preceptors spoke about the students' tendency to go through the motions of a call without actually determining what the underlying problem in the call was.

Excerpt from Vancouver cohort debrief session:

Preceptor 1: And I have to say as an on-car preceptor, when you come out on car, we'll go a code 3 [emergency] chest pain, or we just know we're going to . . . something, but they're all doing the nitro protocol. We have to say, hold on there—we go to "anything." And half of them, well, an eighth of them, it's not a cardiac chest pain. [But the students think it is a cardiac call] because that's what somebody says—or short of breath because they have abnormal breathing. And I think that was a real touch of a real world call—that you're going to a routine man down—Oh! He's been shot in the head! . . . Oh, oh.

Preceptor 2: I just thought it was great to get out and have it all over the JI and not have that standard, structured JI call. You know what you're going for and what you have to do. Half the time out there, you're either not . . . it's not structured—you just have to be ready for anything. That's the way it is when you're out there. You get dispatched for one thing, and when you get there, it's totally different. It's going to happen . . . a lot.

Verbal information discussion. The structure of the PCP program assumes that students will progress from using the PAM as a procedural guide to a process for diagnosis and finally to a problem-solving approach. Yet, the students in this study showed variable use of the PAM, more often using it as a procedural guide than as a process for determining a differential diagnosis. Students did not always make the progression assumed by the curriculum structure. This use of the PAM as a procedural guide limited the students' use of assessment techniques to gather and interpret data. The ability to enter an environment, distinguish the salient features of the situation, and make decisions based on those data emerged as critical missing steps in this study. Thus, in many situations, the students maintained a limited *horizon*, not attending to the richness of the environment that they were immersed in.

Cognitive focus summary. The preceding discussion explored the extent to which participants engaged cognitively with the simulation environment, and how they attended to and obtained information from it. Both preceptors and students actively engaged with the enriched milieu, but the students took uneven advantage of the environment as a source of information. The students tended to focus primarily on the patient and presenting problem and either ignored bystanders and other responders or appeared, in some instances, to view them as distractions. The students tended to verbal information, often paraphrasing and restating other participants' words in medical terminology, and frequently seeking verbal confirmation of their physical findings. Participants in the HF simulations appeared cognitively engaged in a call more than participants in classroom simulations and drills. However, in each setting, participants moved

seamlessly from being engaged in the call to acting as though they were in simulation (e.g., asking for vital signs on an actor or miming a procedure) and back to maintain a relatively unbroken experience. Moments of aporia or confusion were often associated with situations in which they were unable to recognize or interpret some aspect of the simulation experience.

The next discussion focuses on the ways in which the participants interacted with the patient as a manifestation or instance of a condition as compared to as a person with a health history and personal story set within a social and cultural context.

Patterns of Engagement With the Patient

The patient at the heart of an ambulance call is a person with far more than a chief complaint. Yet, the findings in this study suggest that learners may be more engaged with a mental representation of an injury or condition than they are with the patient as a person. In general I found three overall patterns of how the participants engaged in the moment of a simulation environment.

When engaged in a rehearsal of a procedure or series of steps, the attendant practiced or internalized a script for that procedure (e.g., using the mnemonic PQRST to ask structured history questions). The focus was internal and the actor or patient was almost irrelevant. The call at this point was totally predictable and the attendant's engagement was with the "concept of a condition" rather than with the patient per se.

Other times, participants were engaged in an integrative activity, practicing putting all the pieces together and making decisions. The student could anticipate a range of potential outcomes for each action, but did not necessarily know what would happen next. In this mode, attendants were interacting with the patient, but the patient represented an instance of a condition; there was little or no consideration of the patient as a distinct individual.

In the third mode, the attendant was immersed in a call, performing authentic tasks and obtaining information as it would present in the field. There was a sense of dynamism or uncertainty about what would happen next or how the patient and other participants in the scenario would present and react.

Participants engaged in rehearsal in both Core Skills and Classic Case simulations, particularly when the pedagogical purpose of the simulation was practice of new procedures. Participants in the HS simulations typically engaged in integrative and immersive patterns. Interestingly, I found that participants were often immersed in a call but could engage with the patient as either an instance of a condition or as a person. Similarly, some participants would maintain a more personal form of interaction with patients while engaging with the overall environment as an integrative experience.

I entered the study expecting to see more complex interactions between the participants and the enriched physical, interpersonal, and social environment created for the HF simulations. I found instead a richer conception of how they interacted with the curriculum and their ongoing understanding of paramedic practice.

Structure and Function of Reports

The centrepiece of every ambulance call is a patient. Yet, to the patient, the ambulance experience is only one segment of a much longer, complicated, and interwoven journey though and with the health care system. Many patients will interact with first responders, paramedics, triage and bedside nurses, emergency physicians, medical technicians, a family physician, specialists, and other health professionals. The purpose of patient assessment is to determine a provisional diagnosis. The purpose of reports and documentation is to pass on that diagnosis and all relevant information to the subsequent health providers. Within the context of this study,

reports provided a unique window into the practitioners' clinical reasoning and judgment.

While paramedics employ a variety of reports, the following discussion focuses on the report between the attending paramedic and the triage nurse at the receiving hospital. The triage report is intended to be a short, focused description of the patient's presenting injury or complaint, status, and treatment. While the format of these reports seems quite structured, different practitioners tell vastly different stories. Several features of the participants' reports are worth noting: how the reports were organized, what information was presented, what language was used to present findings (e.g., were the findings presented verbatim, paraphrased, or translated to medical terminology), and what narrative structures were used.

The process of documentation and reporting is analogous to the process of narrative analysis. Riessman (1993) posed five levels of representation or interpretation of narrative: attending, telling, transcribing, analyzing, and reading. Each level involves a more comprehensive and nuanced interpretation of information. In a similar fashion, paramedics read the narrative of the call that they are in, analyze the data they collect, and then create meaning. Thus, the participants' use of arrangement, language, structure, and content in their reports and narratives can provide insight to the questions of their engagement, awareness, and decision making in the simulation environment.

Dreyfus' (2001) model of skill acquisition posed a progression in the way that practitioners make and implement decisions. A key features of this model is the increasing importance of context and the need for experience in the development of expertise. Based on this model, I expected to see reports vary in terms of structure, content, and apparent intent. The form, structure, and content of the report may reveal whether the practitioners were using the triage report to structure their own experience or were structuring the report to meet their needs.

The reports should also have provided evidence of the practitioners' use of the clinical reasoning model. I expected to see differences, if not a progression, in the way that participants in the study structured and presented information in their hospital reports, ranging from rote recitations with minimal information to reports that presented likely diagnoses with supporting data, to rich, focused descriptions that presented and defended a choice of provisional diagnosis.

The clinical reasoning literature also identified a number of analytic and non-analytic strategies that diagnosticians bring to their assessment (see Chapter 2). These include the translation of information into medical terminology, the use of semantic qualifiers (translation of the patient's words and presentation into diagnostic signs and symptoms), identification of critical history elements, key features in the patient's presentation, and the use of illness scripts as comparative devices. The presence or use of these devices in the paramedics' reports should provide clues to the richness of their diagnostic processes.

A third lens into analysis of the paramedics' reports was based on my working definition of clinical judgment as an increasing awareness of contextual information and factors in practitioners' actions, decisions, and discussion. Both in their training and in practice, paramedics are expected to note and pass on relevant information about their patients, particularly information that they may be the only ones in the health care chain to notice (such as an elderly patient who is no longer coping at home or a child who may be in an abusive situation). Thus, the paramedics' reports to hospital staff should provide evidence of their clinical judgment and ability to attend to and interpret their environment.

In summary, the reports that participants gave in the simulations provided evidence of their clinical judgment, the richness of their clinical reasoning process, and their journey from novice to expert. I thus structured my analysis to look at the following five points:

- Use of the reporting format (presence and sequence of the elements of a report);
- Presence of a provisional diagnosis (absent, implied, explicit);
- Use of medical terminology and diagnostic language;
- Evidence of clinical reasoning strategies; and
- Inclusion of information or description of interpersonal, physical, personal, social, or cultural aspects of the experience.

Reports findings. While there is an underlying framework to a report, in practice, the stories told in these reports varied in terms of content, structure, emphasis, and intent—in other words, there were both quantitative and qualitative differences. I selected a series of reports for analysis based on their relevance to the features I was exploring. I did not analyze reports from calls in which no report was generated (either no patient, or the patient was treated by an advanced care paramedic crew) or the report was incomplete or missing significant information.

Report format. I began my analysis by noting the order that information was given. The PCP program promotes the use of a common report structure (see Table 15). The intent is to provide critical information in an organized and prioritized fashion.

Table 15. Common elements of a paramedic hospital report

Element	Notes or Description
Age	Patient's age
Gender	Patient's gender. (Note, in some jurisdictions, the patient's apparent race or ethnic background is also given).
Name	Patient's name.
Chief Complaint	Short statement that either describes/characterizes the patient's main complaint or a provisional diagnosis (or list). May be presented as: What is bothering the patient the most (often in their own words) List or description of complaints or condition (e.g., unconscious, chest pain, shortness of breath), usually ordered from most significant or life threatening to least (e.g., substernal chest pain with nausea and anxiety) List or description of injuries, usually ordered from most significant or life-threatening to least (e.g., unconscious, closed head injury, compound left femur fracture, with multiple lacerations to the face and arms) Mechanism of injury (e.g., pedestrian struck; multiple gunshots)
History of the Chief Complaint	Critical history or key features that explore the patient's presentation. Usually includes relevant signs and symptoms or description of environmental or contextual information. May be descriptive or may be organized to imply or support the provisional diagnosis. Descriptive structure may tell the story of the call from the patient's perspective or the attending crew's. When used to support the clinical reasoning process, may be organized as a list of key features in the patient's presentation that are indicative of the provisional diagnosis, or may be in the form of pertinent positives (features that support the diagnosis) or pertinent negatives (features which rule out alternative or other differential diagnoses).
Past Medical History	Usually focused on those elements of the patient's history that are relevant to the present call. A bedside report may also include a comprehensive list or description of the patient's medical history.
Medications	List of prescription and/or over-the-counter medication taken by the patient. May include compliance (how well the patient follows the prescribed dose, route, and frequency)
Allergies	Particularly allergies to medications.
Vital Signs—Initial	Often tailored to the presenting complaint. Beside report may include all diagnostic findings. May be formatted to highlight or forefront abnormal findings.
Vital Signs—Final	Provided if multiple sets of vital signs are taken on a call. Short calls or calls in which the crew is unable to take multiple vital signs (e.g., non-breathing patient who must be ventilated en route) may have only one or even a partial set of vital signs. Again, often tailored to forefront changes or abnormal readings, or changes over time.
Physical Examination	Results of physical exam. Usually focused to forefront abnormal findings or pertinent positives and negatives. May consist of a head-to-toe exam and/or a functional (or systems-based: neurological, cardiovascular, respiratory, etc) exam.
Treatments	Description of actions taken in managing the patient. Usually focused on critical interventions, advanced procedures, and/or drug administration. Bedside report is more comprehensive, providing all treatments or actions.
Response	Changes (or lack of changes) in patient's presentation and condition during the paramedic's encounter with the patient. Usually focused on life and limb-threatening conditions first, with minor changes noted afterwards.
Other	Any other information that is relevant to the call. This may include non-medical information, background on the patient, his/her social environment, events from the scene of the call, involvement of other agencies, etc.

There were no reports from the HF calls that followed the report format exactly (see Table 16). While almost all reports gave the age and gender of the patient, only six of 30 reports (20%) included the patient's name. Fourteen of 30 reports (47%) gave some history of the chief complaint before identifying the patient's major complaint. Three of those 14 reports started by identifying the nature of the call (e.g., "we responded to a domestic dispute and found a 60-year-old woman . . ."). Over half of the reports did not give information on the patient's past medical history (16 of 30; 53%). Similarly, 19 reports (63%) did not include information on the patient's medications or allergies. However, in 12 of those reports, the patient was unconscious and unable to provide that information. Vital signs were given in almost all reports, as were treatments. The exceptions were generally layered response reports from first responders to the PCP crew or the PCP crew to an arriving ACP crew. In these cases, the crew had not yet gathered the information or begun treatment.

Table 16. Report summaries
Note: Total number of reports = 30.

Strategy/Field		# Reports using field	% of Reports using field
Basic Information			
	CC	30	100%
	Hx CC	14	47%
	PMHx	14	47%
	Rx	11	37%
	Allergies	11	37%
	Vitals	23	77%
	Treatment	23	77%
Clinical Reasoning: CC			
	CC verbatim	1	3%
	CC paraphrased	14	47%
	CC implied Dx	12	40%
	CC Dx	12	40%
Clinical Reasoning: Strategies			
	Critical Hx	21	70%
	Key Features	8	27%
	Pertinent +/-	6	20%
	Semantic Qualifiers	17	20%

Chief complaint. Only 1 out of 30 reports (3%) presented the chief complaint as a verbatim quote from the patient. Almost half (14 out of 30; 47%) were paraphrased descriptions of the patient's condition (e.g., "she can't stand up," "found down in a park"). Twelve (40%) implied a provisional diagnosis and 12 presented a clear provisional diagnosis. Several of the reports were categorized as both a paraphrase and as an implied provisional diagnosis. As noted below, some attendants implied or suggested a differential through the organization and presentation of the information.

Use of medical terminology and diagnostic language. Nineteen reports (63%) translated the patient's words and/or physical findings into medical or diagnostic terminology. Several of the calls were more descriptive, relying on the patients' words to describe their presentation.

Use of clinical reasoning strategies. I looked for four specific types of diagnostic strategies: critical history (identification of critical information for specific types of injuries or conditions as outlined in the student's Protocol and Treatment guidelines), identification of key features (choice and highlighting of classic features of common injuries or conditions, such as substernal chest pain indicating cardiac conditions like angina or AMI), use of pertinent positives and negatives (contrasting key features) to rule in or rule out possible (differential) diagnoses, and translation of the patient's words or findings into semantic qualifiers or diagnostic terminology, developed critical histories of their calls, and three of those were fairly weak. Twenty-one reports (70%) developed critical histories. The attendants on two reports required prompting from the triage nurse, and another four reports gave weak critical histories. Only eight of 30 reports (27%) identified or presented key features related to the provisional diagnosis; six (20%) used pertinent positives and negatives, while 17 (57%) translated findings into diagnostic terminology.

Underlying structure. At one level, I was surprised by the varied structures that students used to give their reports. The formal report format is taught early in the program and is reinforced in almost every simulation and call the students perform. Yet, the full format was not used in a single report during the simulations. As I reviewed the cases, however, I noticed an underlying structure to most reports. The paramedic would usually identify the patient (with some or all of the age, gender, name), then briefly outline the nature of the call and problem (a mix of the chief complaint and history of the chief complaint), followed by a summary of relevant findings and treatment. The order that information was given within these categories varied, but the four major elements were in almost all reports.

Organization or intent. I also noted an underlying intent in how the paramedics were

structuring and presenting the information. I created a series of codes based on the categories of organization that emerged.

Some reports were minimalist and given in a rote fashion, simply presenting information from the simulation in the order of the report format. As noted below, these reports tended to be verbatim presentations (using the patient's exact words) and symptomatic (describing, rather than analyzing or interpreting the patient data). Others provided a minimalist interpretation of their findings, perhaps organizing the symptoms in order of their severity. A few (primarily from the ACP crews) presented a provisional diagnosis and then gave information to support that decision and rule in or rule out other differentials. Others presented a chronological telling of the tale, either from the patient's perspective ("She wasn't feeling well this morning. She was in the hot tub for 45 min, and when she got out, she collapsed") or the crew's ("We responded to an incomplete 911. Code 5 [police] brought us into the scene. We found a male with a single gunshot to the head, no pulses, agonal respirations. We started CPR and transported . . ."). A final category had elements of both chronological and supporting a differential diagnosis. I coded these reports as telling a story. In some reports, there was an implied provisional diagnosis and the information was presented in a way to support that inferred diagnosis.

I also noticed differences in the way that the paramedics interpreted the information from the calls. In some reports, the information given was simply rote or verbatim. The patient's own words were given (or a paraphrase of them), and little effort was made to synthesize, interpret, structure, or highlight important information. As well, there were reports in which important information was not passed on. Some reports focused on symptomatic description of the patient, highlighting important features of the case, but still presented the information as data, rather than organizing the information to suggest or support a provisional diagnosis. Other reports were

nicely focused and either implied or stated a provisional diagnosis, or at least brought key features to the forefront. A few reports provided rich detail that was organized in a meaningful way. The final category consisted of almost stream-of-consciousness descriptions that were, indeed, rich in detail, but lacked focus or organization.

Reports discussion. I was surprised by the narrowness of the reports. Only eight of 30 calls (27%) reported significant environmental or social factors related to the calls. While not every call had such factors, a significant number did. One of my assumptions coming into this research was that providing a richer environment would lead to more complex interactions between the participants and other elements of the scenarios. In some cases, this played out. In others, however, the participants either missed or ignored environmental and social elements of the situations they were in. Paramedics on several of the calls ignored the information provided to them by first responders and police officers.

Other times, participants encountered and obtained information in the call, but did not appear to interpret or even include the information in their reports. In the Vancouver calls, an ACP paramedic played the role of the triage nurse. In the Kelowna calls, a nurse who is also a paramedic took on the triage role. In the Vancouver calls, the triage nurse asked a few questions, but basically received the report and ended the interaction. By contrast, in the Kelowna calls, the role fidelity of the interactions between the paramedic crews and the triage nurse was much higher. The triage nurse accepted the report, but immediately began to ask further questions to focus the report, obtain missing information, or explore areas of interest. The nurse also participated in the first part of the subsequent debrief of the call and provided feedback on the report itself. The Kelowna crews' reports included far more information (after prompting) than the Vancouver crews'. And much more detail about the scenario was recalled and presented by

the paramedics under questioning than they initially offered in their reports.

The participants' reports, while not following the format they were taught in their program, did display underlying narrative structures. Through these structures, participants were able to create stories that organized and presented their experience of the call in meaningful ways. The underlying structure of these forms appeared to be related to the participants' engagement in and interpretation of the experience. "Stream of consciousness" reports displayed little organization or interpretation of the events. In Riessman's (1993) terms, these reports demonstrated attending and telling of an experience, but little interpretation of it. Chronological presentations organized events sequentially. Linear forms (the format taught to students in their program) pigeon-holed specific data in an organized fashion, indicative of Riessman's transcription phase. Riessman's categorization of analysis was found in more narrative formats, which implied that the participants had internalized, sorted, and begun to make meaning out of their experiences and the patient data they extracted. Participants who highlighted their provisional diagnosis and presented evidence (such as pertinent positives and negatives) to support their decision—or, going further, created a story-based narrative that sorted, organized, and presented their findings in a persuasive telling of the tale—demonstrated a nuanced and interpretive reading of their experience.

Reports summary. In summary, the hospital reports generally lacked depth and detail and did not reflect the richness of the environment in which participants performed their calls. The reports tended to be descriptive and to report patient symptoms rather presenting and defending provisional diagnoses. With prompting, the participants provided more information and displayed use of a variety of clinical reasoning strategies. Few participants followed the prescribed format for giving a report at a detailed level, although almost all reports had an

underlying structure. Much of the variation in presentation of the reports could be attributed to different narrative styles or formats that the paramedics used to paint the picture of their call. However, these narrative structures also provided evidence of the participants' engagement in and interpretation of their experiences. The range of report formats, and the richness with which they were populated, may be indicators of the participants' ability to extract information from the environment and their use of clinical reasoning strategies. Another important finding from analysis of the reports was that, upon follow-up questioning, participants were aware of far more information than they chose to incorporate in their reporting and documentation.

Engagement Summary

The students in the HF simulations encountered a rich environment that provided multiple opportunities for engagement with a variety of personnel. The participants encountered authentic presentations of diagnostic, social, and environmental situations and challenges. In general, the students were far more immersed and engaged in the HF simulations than in the classroom simulations. They displayed an ability to move seamlessly between being engaged in the call and stepping back to engage with preceptors and partners in reflective discussions. At times, the participants would pop out of the simulation, usually when faced with a flaw in the fidelity of the moment or when encountering a situation they did not understand. Three general forms of engagement emerged, in which participants engaged in simulation to rehearse new skills and procedures, integrated previously learned procedures in prototypical experiences, or participated in novel situations.

The students displayed increased, although uneven, engagement with specific elements of these environments. The interactions between partners and their preceptors was significantly increased. However, the students were less consistent in making use of the patients, bystanders,

other responders, and physical environment in their assessment and decision-making activities. In particular, the students rarely engaged with their patients in a way that acknowledged their health and life histories or social and cultural circumstances. In addition, students often missed opportunities to obtain important information from other participants in the simulations. The preceptors provided ongoing encouragement and coaching, prompting students to attend to the richness of information and nuances of each situation.

The students' reports were varied in format and generally lacked depth and detail related to the use of diagnostic reasoning. The narratives structures in their reports did, however, indicate differences in both the depth of their interpretation of their experiences and their subsequent incorporation of that information in decision making. While the reports themselves were often superficial, in subsequent questioning with both preceptors and the Kelowna triage nurse, the participants were able to recall significant amounts of information that they did not appear to have included in reporting and decision making.

This raises intriguing questions about what information participants choose to attend to during their calls, and how they incorporate that information into their decision-making processes. The next section explores how participants make decisions and what types of clinical reasoning strategies they employ.

How Do Participants Make Decisions in Simulation Environments?

In the introduction to this study, I posed paramedic practice as a social space—a place of collaborative activity, shared decision making, and rich interaction. In this section, I explore how the participants collaborated and made decisions in the HF simulations. I look at types of decisions that participants made and at their use of clinical reasoning strategies.

Big and Little Decisions

The HF simulation environment was deliberately designed to create opportunities for the participants to interact, function collaboratively, and share decision making. My experience in the field was that paramedics constantly talk and interact during a call and that most decisions are shared. I was surprised to find that, in this study, although the environment was active, interactive, and social, the shared decision making that occurred was rarely focused on the big questions of what was wrong with the patient. Rather, the participants constantly interacted in a series of little decisions of what to do next and how to do it.

The overall goal of the PCP program is to develop graduates who can perform an organized patient assessment, intervene in life-threatening injuries and conditions, perform PCP treatments, procedures and protocols, and document and record patient information (JIBC, 2005). Simulations in the program are built around specific learning objectives, designed with the pedagogic goal of assessing and treating specific injuries or conditions. The big decision in every simulation, then, is "what is wrong with the patient?" or "what is the underlying injury or medical condition?"

Decisions findings and discussion. As noted in the Interactions section, the majority of interactions in the HF simulations involved the attendant, patient, partner, and preceptor. The interactions in the classroom simulations, in contrast, focused on the attendant, patient, and equipment. Some classroom simulations involved extensive interactions between the attendant and partner, particularly when the crew had to work together to perform complicated procedures such as spinal management or application of splints. However, these interactions were usually limited to specific points in the call. In general, the partners in classroom simulations were relegated to watching and acting under direction. In the HF simulations, the partners were not

only active throughout the call, but their interactions were a mix of acting under direction, acting collaboratively, and acting independently. And a common form of interaction between partners in the HF simulations was discussion.

Yet, there were few instances in the HF simulations of partners either intervening to redirect the attendant or participating in discussions regarding differential diagnoses. I had initially set up an interaction code for collaborative decision making, but I found that the collaboration in the simulations was based more on activity than decision making. The drivers provided very little in-call feedback or advice to their partners. The discussions that focused on clinical reasoning tended to occur between the attendant and the preceptor, not between the attendant and driver.

The attendant and driver, however, collaborated and discussed a myriad of little decisions throughout the simulations. These little decisions ranged from hints on questions to ask through discussions on what to do next.

In vcr_HFS_08, the crew respond to a man [*sic*] down on the street. Often these calls involve a street person who is intoxicated or has taken drugs and is simply sleeping or lying on the sidewalk. In this case, the two paramedics work together to complete the initial assessment of the patient. These students have not done a call like this in their training and are initially somewhat puzzled about what to do. The patient is obviously not well—he continues to fall asleep whenever they quit talking to him—but they are not sure how to assess him or what to look for. PCP2 (the driver) initially asks what the attendant found on her initial assessment. She asks if the patient is breathing (decreased respirations are a sign of possible drug overdose). She then goes over the Primary Survey findings with the attendant. When the patient responds to the attendant and sits up, PCP2 prompts the attendant to rule out head injuries, and then suggests that

the attendant do an RBS, looking for injuries.

In other cases, the attendant and driver solve little problems involving the choice or adaptation of procedures to the unique context of the call. In vcr_HFS_09, the crew discusses which lifting device to use to transfer their patient from the ground to their stretcher.

> PCP1: ’Kay, so Jeff, we’re just going to get the stretcher and lift you on it and then get you out of here.
> PCP1: <Turns to PCP2.> Do you think we should use the clamshell?
> PCP2: Yeah, he’s just got the leg . . .
> PCP1: He’s not . . . he’s not unstable . . .
> Preceptor: Yeah, but he has the fracture. You have to stabilize the fracture.
> PCP1: The clamshell? ’Kay.

Note that the conversation itself is quite short. Yet, each statement is based on a number of assumptions and principles that guide the crew. The crew has several options for transferring the patient, including using the clamshell, using a backboard, or lifting the patient directly onto the stretcher. The attendant first suggests using the clamshell. The clamshell and backboard are normally used for unstable trauma patients with multiple injuries or for patients with spinal injuries. The driver notes that this patient has only a leg fracture—she implies that the patient is not a multiple trauma patient and does not require spinal immobilization. Thus, the backboard is not required. The preceptor reminds them that they must still use a device to stabilize the fractured limb, so simply lifting the patient from the ground is not a good option. The attendant sums up by confirming that they will use the clamshell.

These types of shorthand conversations were common between the participants. In the classroom simulations, the students worked on flat carpeted or tiled floors in open classrooms. Throughout the HF simulations, the participants completed calls in unusual locations, requiring the crews to figure out how to deal with tight locations, awkward positioning of their patients, uneven terrain, and other complications. The ensuring conversations consisted of similar

references to competing principles of management, discussions on how modify a procedure, and discussions on the advantages of trying other ways of accomplishing a goal. What is particularly interesting is that the conversations were blends of action and speech. The speech is clipped and difficult to follow without reference to the activity it was embedded in. Often, the objects of discussion are only implied, and the meaning is lost when abstracted from the action.

For example, in kel_HFS_02, the crew is working on a pedestrian struck by a vehicle. The patient is lying on a gravel parking lot. The crew is attempting to place a cervical collar on the patient. The collar is a thin device of foam and plastic which is slid under the patient's neck, then wrapped around the neck and secured with a Velcro strap. The device helps secure the head and neck and prevent further movement. The following conversation occured as the crew struggled to apply the collar while working in an outdoor environment on uneven ground and with a patient lying in an awkward position.

Excerpt from kel_HFS_02

PCP1: Student playing role of attendant
PCP2: Student playing role of driver
Patient: Actor playing role of patient
Preceptor: Field paramedic playing role of preceptor

PCP1: You ever had a hard collar on before, John?
Patient: No.
PCP1: 'Kay, it's going to be a little bit restrictive.
Preceptor: You know what? This is on his face. We're pretending that's on his face, so let's take that off of him and just throw that, just so that—it—otherwise, it'll make it—it'll be in your way.
<Preceptor takes the oxygen mask off the patient's face.>
PCP1: All right. We're going to get this collar on you in here.
PCP1: . . .Just down here, okay.
PCP2: All right. <Starts to slide end of hard collar under patient's neck.>
PCP1: Just slide it in . . .
Preceptor: N— . . . yo—you okay, John? You warm enough? You okay?
Patient: All right.
Preceptor: All right.
PCP1: All right.
PCP2: He's not completely on the gravel. Sacrificing my fingers. Just . . . There you go.

PCP1: Would you lift this col— . . . flip this collar, or does it matter?
Preceptor: Well . . .
PCP1: Like, awkwardness.
Preceptor: I know. Let's see what we can do here. It's gonna—like, undo this as much as you can.
PCP1: Mmm hmmm.
Preceptor: Okay. All right, now. 'Kay, slide that in. It's going to—no, it's gonna . . . keep your head down, John.
PCP2: We'll work around you.
Preceptor: It's not going to fit . . . well . . . in this situation. You still need it, and you do the best you can.
PCP1: Okay.
Preceptor: He's not a tall. Not a regular, I don't think.
PCP1: Short.
Preceptor: I would try it only because we've got the collar and that in the way.
Preceptor: Ninety-nine percent of the time you're going to wind up readjusting your collar in the back of the car.
PCP2: Okay.
PCP1: All right. So I'm just going to get this collar slip it under there, under the back of your head, here, okay?
PCP1: Try not to move.
Patient: All right.
Preceptor: 'Kay. You're going to have to come that way. Like that now, see? We're caught in here, but you should be able to get it. There you go. Excellent.

The first part of the conversation involves informing the patient that they are going to put on the cervical collar, then trying to slide the collar under the patient's neck. The collar gets stuck in the gravel and the preceptor tries sliding his fingers in from the other side of the patient's neck to free up the end of the collar. He scrapes his fingers on the gravel but is able to get the end loose. The crew next deals with the awkward position of the patient. His head is turned and tilted forward making it difficult to slide the pointed section of the collar under the patient's chin. The patient starts to move his head to help them, but the preceptor and attendant tell him to stay still—the purpose of the hard collar is to keep the patient from moving his head and neck. The collar does not quite fit and the crew has to loosen a clip and shorten the height of the collar. The preceptor tells the crew to do the best they can and reapply the collar once the patient is off the ground and in the back of the ambulance. The conversation between the crew, the patient, and the

hard collar is neither verbal nor physical—it is more a shared activity than a verbal interaction.

Often, the simulations were punctuated by sudden bursts of collaborative discussion and activity, usually centred around packaging the patient or the performance of a complex task such as spinal management or fracture management. The procedures consisted of a series of interrelated actions that could be performed in a number of ways. For example, packaging a patient on the stretcher involves transferring the patient onto the device; adjusting the backrest to an appropriate height; ensuring that all IV lines, oxygen lines, and dressings are secure and intact; wrapping the patient in sheets and blanket; lifting the side rails of the stretcher; placing straps across the patient's shoulders and trunk; and securing equipment such as oxygen bottles, IV bags, and ECG monitors. Some tasks require at least two people, others are individual. And the tasks can be sequenced and completed in a number of ways (although there are some specific tasks in which the order is important). The completion of the procedure resembles choreography—an intermingling of short questions, answers, and suggestions, nods, gestures, and individual and synchronous motion.

Decisions summary. Most classroom simulations were constructed around a central problem, injury, or condition. Similarly, evaluation was usually framed around determining what the appropriate diagnosis was (making the big decision) and implementing the correct treatment. The participants in the HF simulations in this study engaged in shared decision making and collaborative activity. However, most of their interactions involved multiple ongoing little decisions—from coaching and suggesting alternatives to discussing potential next actions. Their decisions were further embedded in activity—in many cases, it was difficult to break apart the discussion and action. Rather, it seems that the participants were learning to participate in activities that were more than the sum of their individual contributions. This was particularly

evident in the moments of almost choreographed activity that occurred when participants engaged in shared processes such as loading and securing a patient to a stretcher or performing complex procedures or protocols. The participants' blending of speech and action imply that practice is a different way of knowing—more than the addition together of declarative knowledge, procedural skills, and judgment. The students were not simply acquiring and synthesizing skill and knowledge. Rather, the preceptors were guiding them through the process of becoming practitioners through the way they functioned and performed.

Decision making summary. An ambulance call—simulated or in the field—is a site of rich interaction, shared decision making, and collaborative activity. Classroom simulations are structured around injuries and conditions, often arranged by body systems. The central dilemma (the big decision) is diagnostic: what's wrong with this patient? Evaluation focuses on use of clinical reasoning strategies. In the HF simulations in this study, the participants did engage in shared decision making, but the focus tended to be multiple ongoing little decisions of what to do next and how to do it. Participants' collaboration, and indeed the discussion embedded in the interactions, was an intriguing blend of action and conversation. Patterns of mutual support and interaction emerged as participants worked together in activities that were more than their constituent parts. Their blending of speech and action implies that functioning as a paramedic is a way of knowing that exceeds its verbal and kinaesthetic description, and that learning is more a process of becoming than an internalization of discrete skills and knowledge.

This sense that functioning in the field is different, at a deep level, than how students and instructors practice in the classroom is further highlighted by examination of the participants' use of clinical reasoning strategies. Participants displayed the use of many diagnostic data gathering strategies. However, this use was sporadic and uneven. More, the students tended to gather data

that were not always incorporated into their decision making and reporting. In several cases, students appeared to have tunnel vision—making early decisions based on a superficial reading of their experience. This tunnel vision, however, may be evidence of the students using non-analytic reasoning. The students were simply doing what has worked for them in the classroom, where cases are carefully structured and sequenced to provide prototypical examples of common cases in a simple-to-complex curriculum arrangement. When confronted with the unpredictability of field practice, the students lacked a breadth and depth in their experiential database to make good non-analytic decisions.

This section highlighted an emerging theme of my analysis—that functioning within the classroom is different than practice on the street in substantial and fundamental ways. Instructors and preceptors *know* in different ways. And, while the communities they practice in—namely, the classroom and the field—share features and shape each other, they call upon different conceptions of what is *correct* and how to interpret *truth*. Indeed, these differing interpretations underpin the tension between technical and clinical competence and form the context for the final section in this chapter.

What Is Right and True in Simulation?

Instructors and preceptors coexist and influence their students in a state of dynamic tension. Preceptors mock the textbook call and chide students to let go of the rigid approaches they learn in the classroom. Instructors warn their students not to pick up bad habits from their placements in the practicum environment.

I have found evidence throughout this study of the tension between technical and clinical competence. I have presented findings that reinforce the presence of this tension in the way that simulations are constructed, how participants interacted with each other and elements of the

environment, how these elements engaged with each other, and how participants made decisions differently in classroom and HF simulation. This tension was most apparent, perhaps, in the different ways that preceptors and instructors conceived of and assessed *correct* and *incorrect* performance. This section explores how *right* and *wrong* answers were created and justified by preceptors, instructors, and students.

Right Answers

In the first section of this chapter, I noted that the content and structure of feedback given by preceptors and instructors varied considerably. Instructors' feedback focused on pedagogical goals of each simulation, while the preceptors' comments were situational, context-dependent, and difficult to categorize. One of the intriguing facets of this study was the overwhelmingly positive approach taken by the preceptors. There was not a single instance of a preceptor saying to a crew that "you were wrong," or that "you would have failed." The preceptors provided hints, prompted, questioned, coached, directed, provided questions to ask, demonstrated, modeled, and mentored. They moulded, shaped, and facilitated. They assessed and provided feedback, correction, and advice. But, while they critiqued the students, they rarely—if ever—used phrases that implied fault or failure.

Part of this response was due to the structure of the HF simulation environment and the role of the preceptors. The HF simulations mimicked a practicum placement. The role of the preceptor in a practicum includes ensuring effective patient care. Students are allowed, and expected even, to work through the calls in their own fashion. However, the preceptor will not let students go too far off track and is expected to intervene if necessary to ensure that the patient is safe and receives appropriate treatment. Thus, in a practicum setting, a preceptor should never let a call unfold to a point where the student could fail.

In a Vancouver HF simulation (vcr_HFS_11), the crew attend a *man down* call. The patient appears to be intoxicated and there are indications he has taken "some pills." The patient keeps drifting to sleep, but wakes up when questioned. He is a little aggressive, thrashing a bit whenever he is woken. The attendant appears unsure throughout the call. The patient does not easily fit into any of the call categories in the attendant's experience. The patient is not quite unconscious, but obviously not fully aware, even when woken up. His vital signs are confusing—not quite normal, but not quite abnormal enough to worry about. The attendant performs his Primary Survey, but seems unsure what to do next. The patient becomes more agitated every time the crew interacts with him. Throughout the call, the attendant pauses and seems to be thinking. When the patient begins thrashing, the preceptor subtly moves into the scene and positions himself to block kicking motions by the patient. The partner suggests some assessment activities, such as checking blood glucose to see if the patient is diabetic. Other times, she takes the initiative to check vital signs. As the attendant continues to struggle, the preceptor starts asking questions of the patient and gradually assumes control of the call for a short time. The attendant still seems somewhat out-of-sorts, but, with the coaching and prompting of his partner and preceptor, he completes the call. What is intriguing here is that his partner and the preceptor never let the call get out of hand.

By contrast, in a classroom simulation, the scenes are set and the calls play out. Classroom simulations are explicitly organized around the concept of evaluating the attendant. If the student struggles in a classroom simulation, the call simply continues. The partner(s) is (are) explicitly constrained from offering advice (this is framed as cheating), especially in evaluation scenarios. At the end of the call, the instructor passes judgment (*complete* or *incomplete*; *pass* or *fail*) and proceeds to give a post-call critique and feedback. But in the practicum, all participants

share responsibility for the outcome of the call, and so, all are involved in its unfolding.

The preceptors also took a fascinating approach to apparent errors in the call. In a Kelowna HF call (kel_HFS_1), the student chose to treat a non-cardiac patient as though he had angina. She administered ASA as part of her chest pain protocol. In the subsequent discussion, the preceptor told her:

> I need to know what you're thinking. You weighed on the side of doing preventative care. Okay, in case it was cardiac. That's why I allowed you to give the ASA. Okay, 'cause he had no . . . would you have given this gentleman—if he had nitroglycerin, would you have given him nitro spray for this?

The student responds: "Uhm, you know, going through, I would have in the call, to be honest, but now, probably not. I would have investigated his angina—if it was similar. If it wasn't, then go that way." The preceptor went on to discuss how, if they had done this call in the field, the attendant probably would have gathered more information during transport to hospital and would then have made the appropriate choice. The preceptor never directly said that she thought the student acted incorrectly. But her feedback made it clear that she did not agree with the choices and would have done things differently herself. She allowed the student to give the ASA, even though it was for the wrong reasons, because it would not hurt the patient. However, she explicitly told the student that she would have intervened if the student had tried to administer nitroglycerin, which could have had a detrimental effect if given inappropriately.

I noted several instances where students made choices that did not follow the guidelines or training protocols. While the preceptors gave feedback and direction in these cases, they—like the preceptor above—tended to provide correction or redirection rather than directly indicate that the student was incorrect.

I identified 10 simulations in which students made errors which would have been marked as incorrect in a classroom setting. I compared these items to the feedback given by the

preceptors. In general, when the preceptors noted errors, they framed the feedback as advice or suggestions, rather than naming the performance as incorrect action.

One preceptor noted a student error, but told her, “Don’t worry—this is your first time, you did fine.” He framed the error as something he would have done differently, not as something done wrong. Another preceptor noticed that a student had not done an RBS. Rather than frame the omission as an error, the preceptor turned the feedback into an impromptu lesson, asking the student what injuries the patient had. When the student admitted he had missed the RBS, the ensuing discussion is framed around the importance of data gathering, not on procedural error.

One call was dispatched as a 911 hang up, but was actually a shooting and traumatic cardiac arrest. The attendant was slow, on arrival, to gain an understanding of what was going on and initially treated the patient as a medical cardiac arrest. He recognized his own error and, during the post-call debrief, brought it up before the preceptor could. The preceptor appeared more concerned with the student’s angst than with the error.

And these are the calls that will burn you. You’re going to feel terrible ’cause you went in there—and it was like—this is not what I was expecting. This is useless—a 911 hang up, but it wasn’t.

In another case, the error was actually a result of the student taking the preceptor’s advice to move a patient who was uncomfortable. The patient was an elderly woman who had fallen and had hip pain. She was lying in an awkward position, so the preceptor told the students to roll her onto her back. In the curriculum, students are taught never to move a trauma patient until completing a check for other injuries. The preceptor, however, assessed the situation and recognized that the patient was in an unsteady position. The patient was in more danger of further injury from lying on her side in an unsupported position than from having the students roll her in a controlled manner.

In each case, the preceptors turned the feedback into advice or a commentary on working in the field rather than focusing on the apparent procedural or decision-making error. Some classroom errors were not seen as errors in field practice. Others were seen as less effective ways of doing things. But rarely did the preceptors tell students they were wrong. The preceptors' feedback was framed as situational, experiential, and dependent on the context of the moment, rather than as objective, decontextualized observation of the students' actions.

Right answers summary. As noted in the earlier section on roles of the instructors and preceptors, instructors tended to give concrete feedback that was structured around the prespecified objectives of the simulation. The instructors framed actions and decisions as right or wrong, correct or incorrect. Correct answers were based on a pre-existing model or theory of clinical reasoning. Instructors viewed the students' performance through the lens of the curriculum and shaped the feedback they delivered to the experience of the students.

By contrast, preceptors functioned in a much more subjective framework. Their feedback was situational and based on their interpretation of the experience of the scenario. Their assessment called on how things are done "in-the-field" or how the preceptor would have acted. While their source of comparison was embedded in an external framework (how "we do it in the field"), it was far more subjective and situational than the instructors'. The preceptors used evaluation and feedback to shape the experience and understanding of their students.

These different approaches to assessment and evaluation, and their underlying assumptions of right and wrong, further highlight the differences between the two settings. Instructors and preceptors function in different environments, with different rules, and different criteria for success; different systems that call upon different sources of authority and justification. This distinction is taken up in the next discussion.

Source of Authority

There has always been tension between the book and the street. The book, as a metaphor for the formal curriculum, represents the condensed and abstracted wisdom of practitioners that has been sifted, sorted, and set to structure. The street, in contrast, teaches through actions and decisions made in the moment, an experiential way of learning and knowing. Indeed, this tension may be one of the more overt or visible manifestations of the difference between technical competence and clinical competence. One of the intriguing findings of this study is that the book and street, while linked and reliant on each other, call upon different sources of authority or truth. At a fundamental level, instructor and preceptors look at performance through different lenses based on different conceptions and justifications.

I coded the interactions of the students with both instructors and preceptors for the apparent source of authority called upon in their feedback. As I watched these discussions and documented the type and content of feedback, I noticed that preceptors tended to situate their advice or comments within common types of statements, such as "in the field, we do . . ."; "you can't do it that way out there, you have to . . ."; "on calls like this, you have to watch for . . ."—statements that implied a call to truth or authority for the advice they were giving that was different from how instructors situated their feedback. I compared the preceptor statements with how the instructors positioned themselves and justified their discussions.

I developed a set of codes that explored the "call to truth" for the preceptors' and instructors' feedback and comments—a way of categorizing the source of authority that the preceptors, students, and instructors used to justify their actions or comments (see Appendix B, Table B9). Table 17 presents the results of coding instructor and preceptor feedback.

Table 17. Distribution of apparent source of authority for feedback given in Classic Case and HF simulations

Source of Authority	253 Debriefs		HFS in call		HFS debriefs	
Other			13	7%	7	4%
Unique needs			37	20%	23	14%
General principle of management unstated	1	3%	59	31%	15	9%
Curriculum principle of management	21	54%	4	2%	5	3%
Curriculum protocol	11	28%	4	2%	2	1%
Field protocols			3	2%	2	1%
Field general practice			29	15%	49	30%
My experience	1	3%	13	7%	41	25%
Clinical science	2	5%	18	10%	12	7%
Scene/situational awareness			6	3%	5	3%
Functioning in sims	3	8%	1	1%	1	1%
Being professional			1	1%	1	1%
Total	39		188		163	
Informal sources		5%		75%		80%
Formal sources		87%		14%		12%

Source of authority findings and discussion. Classroom simulations are structured around predetermined pedagogical points, with structured feedback that is directly linked to the patient assessment model, training protocols, principles of management, and clinical sciences as specified in the program's textbooks. As noted in the previous section on feedback, 40% of instructor feedback was related to equipment, call management, protocols, and treatment. The rationale and justification for this feedback drew upon curriculum material and training protocols.

By contrast, the preceptors gave much more situational feedback, focusing on a range of topics so broad it was difficult to categorize. The justification for their feedback often highlighted ambiguity and the need to consider or weigh a variety of factors in the decision making. For example, in vcr_HFS_01, the crew attended a 70-year-old man who fell in the hallway of his care home. He suffered a fractured hip. In the debrief, the preceptor commented on the attendant's initial approach to the call:

Preceptor: Okay, so did you feel like this was going faster?
PCP 1 (attendant): Oh yeah.
Preceptor: Okay.

PCP 1: Yeah.
Preceptor: All right. And that's almost universally what happens on car.
PCP 1: Yeah.
Preceptor: Things go fast. Okay. Not necessarily really fast, but it goes faster. What did you—what did you notice when you went out there? Think about when you walked up to the scene, what did you notice?
PCP 1: Before I got to him?
Preceptor: As you're walking up to him, you can see him, you can see the care aide frantic.
PCP 1: He's awake and ah, he's in pain. And there's obviously something wrong with his leg.
Preceptor: The care aide said?
PCP 1: Ah, she found him on the ground.
Preceptor: "I think it's his hip. "
PCP 1: Yeah.
Preceptor: Okay. It's not always the right thing, but you know she's probably got a pretty good sense of what's going on because she's been waiting there for us to show up.
PCP 1: Uh hm.
Preceptor: All right? "What's the problem?" "Oh it's my hip—it's my hip." "Oh, all right. I think it's his hip, too." Okay?

Preceptor: Your rapid body assessment was not rapid. Was not . . . Yeah—yeah. It was—it was too slow. It shouldn't—it should be much quicker than that. You have an obvious injury that you can see. Yes, you don't want to miss something else, but all the other indications are that this is all you've got. He's like—he's alert, oriented, and talking to you, and he's telling you about his hip pain, and he's healthy standing. Um, he's got really low incidence for C spine. Ah he is 70—puts him back up in the higher end. Could you have collared him and been correct? Yes. Because? What?
PCP 1: He's older so he's got higher brittleness for his bones.
Preceptor: Higher—higher suspicion of a break, so . . . collaring—not collaring—that's a judgment call.

The preceptor gave two pieces of feedback. In the first, he told the attendant to complete his initial survey for injuries (the RBS) both more quickly, but also in a more focused manner. In this call, the preceptor told the student to judge the overall situation and to focus the assessment by considering the mechanism of injury. The preceptor prompted the student to start his assessment even before reaching the patient. He noted that the patient is lying on the floor with an obvious leg injury. He also prompted the student to notice the comments of the care aide. Then, during the RBS, the preceptor called back to information gained on approach to state that the only other likely (serious) injury might be a spinal injury. He encouraged the student to do a quicker RBS by focusing on the likely injuries (while still not missing "something else").

The second feedback item involved deciding whether to treat the patient as a spinal patient and use a hard collar to stabilize his head and neck. Again, the preceptor told the student that it is a "judgment call"—that the patient is older with more brittle bones. But note that the preceptor did not tell the student which way to treat the patient—rather he focused on the fact that the student must decide for himself, based on his assessment of the mechanism of injury and presentation of the patient, whether to apply the hard collar.

Neither piece of advice had an explicit call to authority or obvious objective, external justification. And, in fact, both suggestions contradicted the curriculum. Students are explicitly taught to perform a thorough RBS, regardless of the mechanism of injury. And there are indications for triggering the use of spinal precautions that are, again, context independent. Yet, the preceptor here situated both pieces of advice within the overall context of the call. He did not tell the student that there is a *right* or *wrong* way to treat this patient; the use of spinal precautions is, rather, a "judgment call"—a decision to be made in the moment, based on the attendant's overall assessment of the situation. The patient did not meet the obvious triggers or indications for spinal management (no injury above the clavicles; no history of hitting his head). But the patient is also elderly, with "brittle bones," so the attendant has to consider the possibility. Intriguingly, one piece of advice implied that the textbook process is too rigid (you can actually do a focused RBS if conditions merit), while the other piece of advice exceeded the standard criteria (even though the patient does not meet the indications for spinal injuries, you might consider the possibility because of the patient's age and condition).

Most preceptors gave advice that either varied from or contradicted formal policy and protocols. The crew in vcr_HFS_18 attended an infirm elderly male who was being cared for in his home. Some of his adult children felt that they could no longer cope and have called for an

ambulance to take the patient to the hospital. Other family members want the patient to remain in the home. The patient himself has ongoing abdominal pain and a decreased level of consciousness. The crew transports the patient.

On arrival at the hospital, the triage nurse asked if the crew started an intravenous line. The crew replied that they had not. The preceptor noted that starting an IV is “not a protocol, really,” but that paramedics often start an IV when they think that the hospital will want one. Similarly, one of the preceptors in the Kelowna HF simulations informed his students on several calls that, if the patient will get an IV in the hospital, then he will start one en route to the hospital. Thus, the preceptors in both locations encouraged the students to function outside their formal protocols based on what is common practice in the field. The “call to truth” is not established policy or written protocols, but rather a practical, generalized principle of management that has grown through experience between practicing paramedics and their receiving hospitals.

In each of these situations, the justification for the advice given was not to external criteria or formal protocol, but to experience and intuition (in the Dreyfus [2001] sense of non-analytic decision making).

In Table 17, note that 82% of the feedback in the Classic Case debrief sessions called to curriculum materials and curriculum protocols for justification. Only 5% of the feedback given called on informal sources of authority (experience, general practice in the field, and generalized principles of management). In contrast, preceptors’ feedback was strongly supported by experience, field practice, and generalized principles of management. The preceptors called upon the unique needs of the patient for 20% of the feedback they gave during the calls, and 14% in their post-call feedback. This is consistent with the situational nature of their feedback.

There were differences in the source of justification for the feedback given in-call and after the call. During the calls, the preceptors' feedback tended to call upon generalized principles of management and adapting to the unique needs of the patient at hand (51%), reflecting a focus on performance in-the-moment. In the post-call discussions and debriefs, the preceptors tended to focus more on general issues. This was reflected in calling less to the unique needs of the patient and principles of management (23%) and more to the preceptor's personal experience and references to "how things are done in the field" (55%).

What is particularly intriguing is that the preceptors' feedback, however, was overwhelmingly based on informal sources of authority (75% for in-call and 80% for post-call). While instructor and peer feedback called to objective, external sources such as curriculum material and training protocols, preceptors called to either internal ("in my experience") or subjective, social ("in the field, we . . .") sources of authority.

Note, also, that clinical science was rarely used to support feedback from either the instructors or the preceptors. This may be due to the types of calls and dilemmas that the participants were engaged in. Most of the scenarios were structured around relatively straightforward medical conditions. The dilemmas in the scenarios involved dealing with multiple people in a scene, environmental/physical challenges, and interpersonal/interagency situations. The feedback given by preceptors was, as noted previously, situational and scattered across a wide number of topics. Only 10% of the feedback given by preceptors was related to treatment or use of protocol, and another 5% referred directly to the underlying injuries or medical conditions. Thus, the low call to clinical science is consistent with the type of feedback given. However, this still raises intriguing questions as to why so little feedback focused on the medical basis of the calls.

This finding is also consistent with literature from medical education that has indicated that experienced diagnosticians rarely make explicit calls to clinical science to determine or defend their decisions. Schmidt and Rikers (2007) posed the concept of encapsulation of basic science with experience into the development of illness scripts that guide practice. Schön (1983) and Lave and Wenger (1991) referred to the solidification of experiential understanding into an unarticulated corpus of tacit knowledge that guides the experienced practitioner.

Call to Truth summary. The analysis of the apparent source of authority for instructors' and preceptors' feedback further highlights the tension between technical and clinical competence. Instructor feedback calls upon formal sources of authority that relate and evaluate student performance to curricular goals and objectives. The feedback is focused on developing consistent patterns of response to predetermined problems. By contrast, preceptors call upon experiential knowledge and personal experience to show students how to recognize and adapt to the unique features of the dynamic environment of field practice.

What Is Right and True in Simulation Summary

The findings and discussions in this section highlight the overlapping but distinctly different approaches and rationale employed by instructors and preceptors. Instructors function in a preplanned setting where simulations are structured around right answers and expected performance objectives. Their assessment and feedback explicitly judges acceptable performance and articulates their rationale based on formal sources of authority, such as curriculum documents, texts, and published protocols. By contrast, preceptors function in an unpredictable milieu, tend to judge performance on adequacy to the situation, and provide situational feedback that calls on pragmatic and experiential sources of authority.

These distinctions are more than semantic—they represent fundamentally different ways

of conceiving practice, interpreting and giving meaning to experience, and judging and shaping performance—a difference framed and defined as technical competence and clinical competence. And the tension between these two differing world views manifests in the learners' experience of the gap between technical and clinical competence.

Chapter Summary

In this chapter, I have presented my initial analysis and interpretation of data, organized into five conceptual categories. These categories speak to the experience of the participants and address how we teach and learning in simulation, how participants interact, function, think, and make decisions in the simulation environment, and the ways in which instructors and preceptors judge and assess learners. The final chapter of this thesis extends this analysis through synthesis and interpretation of the findings in relationship to the core concepts from which this study emerged.

CHAPTER 6: INTERPRETATION AND IMPLICATIONS

In Chapter 1, I posed a practical problem, identified unchallenged assumptions, highlighted taken-for-granted conceptions, set a dilemma, and chose a point of entry from which to approach and explore the research goal and questions. Having presented my findings and analysis in the preceding chapters, I move now to interpretation and implications by relating these findings to the study's goal, dilemmas, conceptions, assumptions, and practical problem.

Re-Examining the Research Goal: Learning as Emergence

If simulation-based learning environments are to supplement or replace practicum experiences effectively, they must be able to support the development of clinical judgment. Thus, a central goal of this study was to explore how learning emerges in professional education settings.

Current paramedic education programs embody a conception of learning as additive and stable, in which the pedagogic whole is the sum of its parts, and through which learners encounter and master curricular content in a more or less predictable progression. Curricula are envisioned and enacted as a closed system in which learners develop skills, knowledge, and judgment that are situated in, but not a part of, the context in which they will be used. Instruction, assessment, and evaluation focus on supporting learners as they accumulate progressively complicated chains of foundational knowledge and procedural skills. Classroom simulations and the field practicum are seen as linked environments, with the gap but a momentary disturbance as learners move between performance domains.

This study provides evidence of progression of learning, both in the types of learning activities used and in the participants' experiences during those activities. Intriguingly, however, the findings in this study suggest that learning is less linear, less stable, and yet more

comprehensive than the program's underlying curriculum framework suggests.

The Progression of Learning

The idea that learning involves ongoing progression is embedded in many theories of learning and curriculum development. In a survey of common theories and processes emerging from the discipline of instructional design, Romiszowski (1981) articulated explicit and implied concepts of progression in Skinner's (as cited in Romiszowski, 1981) behaviourism and programmed instruction, Gagné's (1970) hierarchical ordering of eight categories of learning, Piaget's (1947/2003) progressive stages of cognitive development, and Bruner's (1977) levels of representation from enactive to iconic to symbolic modes. The learning theories examined in Chapter 2 variously expressed the progression of learning as increasingly complicated skill and procedural chains (Hunter, 1994); laying down of hierarchical memory and relationship structures (Driscoll, 2000); the extension, development, and reorganization of personal mental representations (Fenwick, 2003); assumption of increasingly authentic roles and patterns of performance within a group or community of practice (Lave & Wenger, 1991); and the emergence of increasingly nuanced and sophisticated potential responses to novel situations (Davis & Sumara, 2006).

The design of the JIBC's paramedic programs embeds the concept of the progression of learning in the structure, content, and delivery of the program, evidenced through the use of a strong central theme and a simple-to-complex chaining of concepts and procedures that are structured in a building block progression of activities, lessons, and courses. The progressive structure of the program is further reinforced through a hierarchical use of practice learning activities that build in complexity and richness. The program's delivery model mirrors Bruner's (1977) levels of representation from abstract to enactive: learners start each course with

independent study of abstract content which is then applied in classroom sessions and simulations before being used in the field practicum. Evaluation structures mirror the progression of learning activities and are designed to ensure that learners demonstrate competence of key skills and knowledge before moving to the next component of the program.

Evidence supporting the progression of learning. The progression of learning is apparent in both the structure and use of instructional activities and in the participants' performance in this study. Core Skill simulations had simple stories, low physiological and environmental fidelity, and were used by learners to rehearse new skills and apply new knowledge. Classic Case simulations presented learners with richer stories, different potential paths, and were often staged outside the classroom in more realistic settings. The HF simulations were staged as open-ended situations, with increased role, physiological, environmental, and social fidelity. Learners demonstrated a steady progression through the program in the smoothness and confidence with which they performed common procedures, such as the choreographed process of loading a patient onto the stretcher and securing equipment. The role of the driver evolved from a disinterested partner who performed only under direction in Core Skills, through the *smart pair of hands* who worked alongside the attendant in Classic cases, to the engaged partner who (albeit with ongoing encouragement from the preceptors) began to initiate activities and participate in decisions in the HFS environment.

The sense of progression in the current curriculum is further evident in the interactions between learners and instructors. In both mastery learning and cognitive apprenticeship approaches, instructors initially provide close support and coaching early in a program, and then slowly remove instructional scaffolding as learners work through the course content and develop competence (Brown et al., 1993; Hunter, 1994). The interactions between instructors and learners

in the Core Skills and Classic Case simulations support this approach. Instructors provide active coaching in-the-moment focused on performance of specific skills during Core Skills drills. In the Classic Case simulations, the instructors observe without intervention and attempt to remain as unobtrusive as possible. Learners complete entire simulations before receiving post-simulation feedback and correction.

The presence of progression is also supported by analysis of the feedback given by instructors and preceptors into the categories in the Dreyfus (2001) model of skill acquisition. Slightly more than half the feedback given in Core Skills (55%) was ruled-based and categorized in Dreyfus' (2001) first category of novice. While feedback in the Core Skills was directed at individual skills and correction of technique, instructors in the Classic Case simulations looked at a bigger picture, providing correction within the context of the current call (85%); aimed at call management, treatment, and overall conduct of the simulation (72%); and focused on application of principles and consideration of situational factors (73%). More than half (63%) of instructor feedback in the Classic Case simulations was coded to the advanced beginner category. Finally, half the feedback given by preceptors was coded to the categories of proficiency and expertise.

Evidence that challenges the progression of learning. However, I also found evidence that suggests that the learners' experience is neither as linear nor progressive as suggested by the instructional framework and structures of the program. This evidence suggests that the move from the classroom to field practice is more than a simple transition between, or extension of, linked learning environments.

The structure and use of the JIBC's Practice Ladder and the progression in categories of the Dreyfus (2001) model of skill acquisition both imply a hierarchical progression in learning. Both models acknowledge that learning overlaps categories as learners move from one step or

stage to another. The implication, however, is that at each level, learners have acquired the subordinate skills and met prerequisite objectives before progressing to the next level or stage.

In practice, however, the Practice Ladder activities themselves are not exclusive and do not necessarily build upon each other. Instructors and preceptors mixed methods even within the use of the Practice Ladder categories to meet specific and immediate learning needs. There were several instances in which preceptors would conduct impromptu skill drills during a HF simulation, such as when the Vernon preceptor demonstrated and worked his learners through the steps of applying a hard collar on uneven ground.

While the analysis of the feedback given by instructors and preceptors in the previous section tends to support the progression of learners through the categories of Dreyfus' (2001) model, there were, nevertheless, several interesting findings that also challenged the notion of progression of learning. The instructors tended to focus on procedures and maxims—features associated with Dreyfus' (2001) Advanced Beginner stage. Yet, even in these Classic Case simulations, where the instructional strategy focused on integration and practice, one quarter of the instructors' feedback was on higher order competence and proficiency concepts such as identifying salient features of cases or identifying acceptable alternative approaches to the correct approach. Preceptors, whose goal was to transition students to field practice, nevertheless gave 21% of their in-call feedback on rules and principles related to skills and procedures for which the students had already successfully demonstrated mastery. Students in both classroom and HF simulations continued to require feedback on previously learned competencies. As well, instructors often gave feedback on objectives related to integration and adaptation during early components of the program before these objectives were covered in the curriculum.

The implied progression from the classroom to the field was also challenged by the

differing ways in which the instructors and preceptors engaged with the learners. The instructors' interactions in the Core Skills and Classic Case simulations showed a reduction in scaffolding as the course progressed (see discussion above). However, as the students moved into the practicum setting, the instructional support did not recede further into the background. Rather, the preceptors became active participants in the simulations—prompting, coaching, directing, acting in parallel, and even stepping in to take over the calls at various points. Thus, preceptors were not reducing their role as learners progressed from procedural classroom based simulations to simulations in a field setting—the preceptors actually increased their support at times.

The preceptors' interactions mirrored a similar diversity in the participants' performance. The Practice Ladder implies that, in the practicum setting, learners should focus on adaptation, integration, and differential diagnosis. Yet, students participating in HF simulations in this study received feedback on a range of topics so broad that it resisted categorization by competency or learning outcome. Learners who had completed the program's final exams and demonstrated competence in their PCP skills entered the HF environment and struggled with simple skills such as applying a hard collar, neglected to talk to bystanders and police officers as they approached a scene, and required ongoing prompting to initiate tasks and procedures when in the role of the driver. The Practice Ladder implies that performance in a field setting is a function of integrating and adapting previously mastered skills. Yet, the students' interactions in this environment often seemed to be at far lower levels of functioning. And, at other times, the participants entered complex situations and appeared comfortable, easily accepting information and coordinating the actions of partners, first responders, and bystanders.

Discussion. Curriculum metaphors that employ construction or mechanistic metaphors (e.g., building block, simple-to-complex) imply a linear and progressive acquisition of learning

that remains stable. However, the findings in this study suggest that learning is richer, more variable, more context-dependent, less predictable, and more asynchronous than expected. Learners in Core Skills were already learning how to integrate and apply simple procedures and were receiving feedback aimed at discrimination and adaptation. Learners in the practicum setting stumbled with simple tasks and made errors of both judgment and execution. In practice, both instructional activities and learning outcomes were a mix of the intended goals and peripheral learning.

The current program is built on a competency-based framework, presenting and organizing its activities and structure through construction-based metaphors. The skill of taking a blood pressure, for example, is seen as a discreet competency that is initially mastered as a skill, and then integrated as part of a procedure (taking a complete set of vital signs) that is performed within a call (simulation or a call in the field). In this framework, the skill itself is seen as stable and its evaluation remains essentially unchanged in different performance domains and contexts. Developing competence is evaluated as the ability to obtain blood pressures quickly, consistently, and independently. The criteria for judging performance, such as the observable behaviours on a mastery checklist, remain unchanged across different performance domains. The competency structure is hierarchical; each level is construed as a sum of its subordinate elements (see Figure 26).

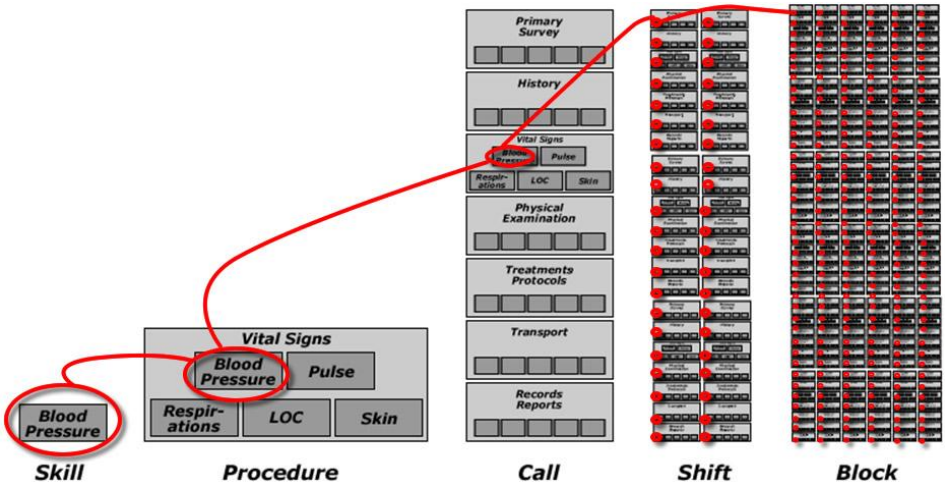

Figure 26. Competence as building blocks. The skill of taking a blood pressure is conceived as stable and unchanged as the practitioner incorporates it into take a set of vital signs, and as those procedures are integrated into performing ambulance calls, completing multiple calls per shift, and through ongoing "blocks" of shifts throughout the practitioner's career.

The structure of the existing paramedic program presumes a consistency of experience and action across instances of similar learning activities. The program explicitly develops patterned sets of experiences designed to ensure that all learners cover the same material, practice the same skills, and link these into the same set of instances and experiences. The goal is to establish consistent performance as the end point of instruction. The assumption of the similarity of these learning activities is mirrored by the assumption that learners will progress through these experiences in a similar fashion and reach the same outcomes. Indeed, this is the strength of the current approach: simulations are seen as closed systems with stable inputs, clearly articulated predetermined outputs, and expectations of consistent performance.

However, in this study students struggled when confronted by the open-endedness of the HF simulations that replicated a practicum environment. And it is here where adopting other perspectives provides a richer view of learning within a simulation environment.

Writers from ecological and complexivist perspectives (see, for example, Doll, 1993;

Maturana & Varella, 1987) posed learning as a dynamic phenomenon involving adaptation and integration of new stimuli or experience with past experiences and abilities. When learners encounter changes or perturbations in the environment, they change and adapt to the new conditions. The resulting adaptation is itself a perturbation, and becomes new input for further adaptation and change (Fenwick, 2003). In this view, skills, knowledge, and judgment are not seen as stable constructs, but as ever-adapting and changing reactions to a dynamic environment. "Living things constantly remake themselves in interactions with their environments" (Kincheloe & Berry, 2004, p. 38).

In contrast to existing building block conceptions, metaphors of emergence and nestedness seem to better account for the uneven and idiosyncratic way that learners encountered and engaged with their environment in this study. Davis and Sumara (2006) posed learning as adaptation and emergence of potential responses to the environment at a higher level of complexity:

> Brains, social collectives, bodies of knowledge, and so on can all become broader, more nuanced, capable of more diverse possibilities. Further, each of the phenomena arises in the interactions of many sub-components or agents, whose actions are in turn enabled and constrained by similarly dynamic contexts. (p. x)

Viewing the development of competence as emergence acknowledges that learning involves multiple encounters with ideas and activities in a variety of different situations. This, in turn, implies that previously learned skills or knowledge are *relearned* when attempted or applied in new contexts.

Thus, students stumble in new settings because they are learning something *new*, not simply adding together discrete, previously mastered steps in a new performance domain. In an emergence-based paradigm, learners are not adding skills to a new situation, they are actively developing responses in and of a new a skill-and-context combination. Skills (in this sense,

potential responses to situations) are always being learned within a context, even if that context is deliberately constrained, as in a skill station.

Kincheloe and Berry (2004) emphasized that knowledge is always situated in social, cultural, and political contexts. Davis and Sumara (2006) presented several examples of nested structures. Complex systems are comprised of, and form part of, other complex structures. This concept of overlapping, nested systems is particularly useful when considering learning and clinical competence as complex phenomena.

Hence, "taking a blood pressure" is not simply a set of psychomotor actions. In practice, it is a series of steps that must be integrated within the overall flow of the call and adapted to the needs of the patient within the unique experience of a particular situation. When one of the students in a Kelowna HF call needs ongoing prompting to take a blood pressure, it is apparent that it is not the skill that is at issue. Rather, it is the student's uncertainty of how and when to interrupt his partner's interview; his unwillingness to break into the circle of patient, partner, and bystanders; and his unease at initiating activities without direction from the attendant. The classroom simulations were structured and predictable. Now, however, the student must deal with a number of ongoing activities and with the intentions and actions of several participants in the call. The student must function in an open system consisting of multiple interacting elements. The perturbation of incorporating familiar procedures within a dynamic environment invokes processes of both assimilation and accommodation as the learner encounters a new performance environment which requires paradoxical blends of autonomous action and collaborative activity.

Thus, the procedure of "taking a blood pressure" is not a stable construct that remains unchanged as it is incorporated into the practitioner's experience. Rather, each instance of taking a blood pressure is embedded in the context of its performance; taking a blood pressure on a

pediatric patient in a home is different than taking a blood pressure on a multi-trauma patient lying on a roadway in the rain. These multiple instances are linked experiences with common elements, yet each is qualified and modified by the context of its performance. These procedures are further intertwined with other assessment and treatment procedures, and the resulting shape or metaphor for developing knowledge and expertise better resembles a rhizome (see Figure 27) than a building block structure (Deleuze & Guattari, 1987).

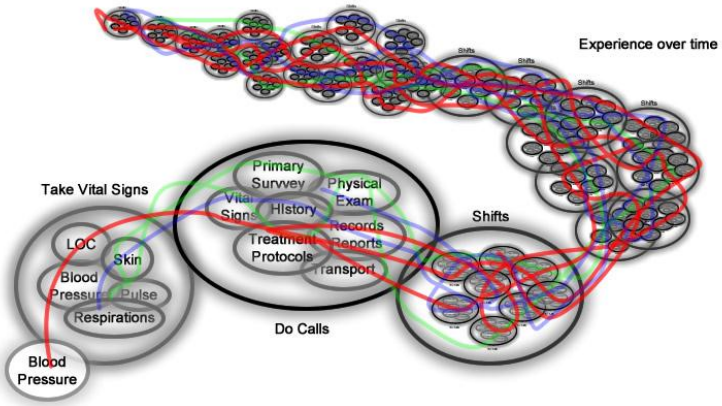

Figure 27. Adaptation of a skill over time as a rhyzomatic relationship. “Taking a blood pressure” as an experience that is incorporated into a growing body of similar, yet distinct experiences.

Summary

The learning environment is a complex space involving the goals of the program, the needs of the learner, and the intent of the instructor. Metaphors of learning as construction speak well to the instructional aspects of this environment. Tools such as the Practice Ladder are useful constructs for matching desired learning outcomes with effective instructional strategies. However, these metaphors imply a causal and temporal progression that does not mirror well how learners experience and engage with the learning environment. The HF simulations, in particular, present several challenges to the progressive and hierarchical assumptions of learning

that underlie the structure of the Practice Ladder. Both learners and preceptors engaged in HF simulations in ways that were at odds with these assumptions.

Returning to the Point of Entry: Clinical Competence and the Process of Discernment

Two conceptions of competence stand in contrast throughout this study. *Technical competence* is defined the consistent, independent (uncoached), timely, accurate, and appropriate performance of skills, knowledge, and judgment as outlined by an external authority and assessed through observable behaviours. *Clinical competence* emerges as a more holistic assessment of a practitioner's ability to adapt and integrate procedures and strategies to the unique needs of the moment within the dynamic, social environment of field practice. Where technical competence seeks consistent performance across instances and contexts, clinical competence highlights the practitioner's ability to discern and adapt to the salient features of a particular situation.

Contrasting Technical and Clinical Competence

The structures, activities, and evaluation of the current program focus on the development of technical competence. While there are strong links to the field environment, including practicum placements in both clinical (hospital) and field (ambulance) environments, the dominant processes and evaluation criteria remain geared towards technical competence. This emphasis is embedded in the *NOCP* (PAC, 2001) which, while recognizing varied performance domains, maintains the same definition of competence (consistent, uncoached, timely, and appropriate performance) across all performance domains.

Traditional curriculum design approaches consider the learning environment as a closed system (Romiszowski, 1981). The current program presupposes the development of technical competence as acquisition of hierarchically organized, increasingly complicated skills and

knowledge. Technical competence is achieved through demonstration of the competencies that define the discipline. Early objectives in a course are often low level, task oriented, behaviourally based statements. Learning outcomes at the end of a program are presented as integrative statements that bring together the bits and pieces of the domain into a few broad goals. Learning experiences, including simulations, are planned, with carefully crafted scripts that highlight key features of specific conditions in an effort to build experiential mental pictures of common types of injuries and conditions. The explicit goal is to establish specific and predictable patterns of response to known problems (Schön, 1987). Technical competence has, in its attainment, a sense of closure or arrival.

Throughout this study, preceptors took a very different approach with their students. Clinical competence focuses on processes of awareness and adaptation. Where current lessons and simulations are carefully constructed experiences following a prescribed sequence, preceptors create meaning by starting with the situation-at-hand. Preceptors focus on discerning and choosing which elements of the environment to attend to, and use abductive, nonanalytic reasoning approaches to develop a general sense of what is happening, and from which they can make sense of the situation. This process involves sifting, sorting, and weighing which evidence and data to consider. Preceptors encourage students to form an impression, and then tailor their subsequent activities accordingly. Thus, preceptors do not prompt students to follow a predetermined set of questions; rather, they encourage students to ask their questions in multiple ways, to explore more richly what the patient is telling them, to adapt and modify their history-taking to extend and understand the patient's story. They show the students how to look for anomalies and exceptions and to notice what in the environment is unusual or does not fit. The preceptors seem to find meaning as much in the differences between cases as in the similarities

of the case at hand to previously memorized exemplars (see Derrida, 1982).

The process of attending to and assessing the environment, which is termed *discernment* in this study, emerges as a missing critical element in the development of clinical competence and clinical judgment. The following discussion explores the development of clinical competence through three trends in the students' performance.

Primacy of verbal information. As noted in Chapter 5, students obtained varied forms of patient assessment data in different types of simulation-based learning environments. Despite increasing richness of the scenarios and the use of more authentic locations, students remained reliant on verbal descriptions and information. Even in the Classic Case simulations, students received substantial and important information as verbal cues and descriptions of physical findings and activities. The students frequently verbalized procedures ("We'd use a fore and aft lift to move the patient to the stretcher"), often supplemented by miming or mirroring activities. This reliance on verbalized behaviour and information continued into the HF simulations. While the HF calls generally had higher environmental, physiological, and procedural fidelity, some information had to be provided verbally by call managers (e.g., abnormal vital signs on a simulation where an actor is the patient). In addition, students continued to use mirroring, miming, and verbalizing throughout the HF simulations. Some students continued to verbalize their actions as they worked through the call, although preceptors coached the students to internalize these verbal self-prompts. The reliance on verbal information was apparent even when students encountered HF mannequins and moulaged patients.

The reliance on verbalized information seems to have two sources. The first is unfamiliarity with the prehospital environment; many of the students were new to EMS and had never seen actual injuries or even moulaged actors. Preceptors and ACP students had little

trouble recognizing and distinguishing between bruising, lacerations, and fractures. The experience of these participants gave them an interpretive advantage over students who had no prior exposure in their backgrounds to patients with these injuries.

The second source of reliance on verbal information seemed to be learners' unwillingness to interpret and commit to their interpretation of their visual and experiential findings. Throughout their program, students were given key diagnostic information by call managers. The information was usually presented in medical or diagnostic terminology and was structured to provide prototypical descriptions of the injuries or physical findings. The students often knew what the underlying type of problem was before entering the simulation. Thus, the students rarely had to make diagnostic decisions with the data. Rather, the data were being supplied as an instance of the type of condition being practiced. By contrast, the students in the HF simulations had no idea what type of call they were entering, how acute the presentation of the patient would be, or how apparent or hidden diagnostic data would be presented. Even when presented with physical findings or when patients answered questions about their history, the students tended to reframe the information in medical terminology and often sought confirmation or validation of their interpretation from the patients or call managers.

Linking data to decision making. The participants in this study often demonstrated use of the clinical reasoning *procedure* at the expense of its *outcome*; they asked the appropriate questions and performed the required actions, but often neglected to incorporate the information they obtained into their decision making and reporting. Students also tended to follow the procedures of patient assessment and differential diagnosis without actually interpreting the information that they were receiving. Many of the hospital reports were cursory and none of the reports provided all the information that should be given. Yet, when questioned by the triage

nurse or preceptor after the call, the students often had gathered significantly more information than they passed on or considered in their diagnosis and decision making. These tendencies led to decision making that was sometimes shallow and occasionally significantly disconnected from the apparent needs of the patient.

Analytic and nonanalytic reasoning. This study also provides intriguing evidence that the students tended towards use of nonanalytic decision making, even though they were novice practitioners. Both Klein's (1997) recognition-primed decision making and the evolving discussion on clinical reasoning (see, for example, Molton et al., 2007; Norman, 2005) suggested that practitioners develop an experiential databank of instances over time that serves as a source of making recognition-based diagnoses. In this study, students often formed initial impressions that quickly became their provisional diagnosis. Even when presented with contradictory evidence, the students persisted with their initial decision. Students often formed an early impression and proceeded to perform the type of call that they recognized. Despite their limited experiential databank, these students passed over analytic processes in favour of the immediate nonanalytic or intuitive decisions.

Discussion. In each of these examples, students were not noticing what was unique, specific, or different about the situation that they were in. Throughout their training, students have been coached and guided towards consistent performance of procedure. Instructors isolate and provide prototypical information, often given verbally, that students need as they progress through the simulations. Instructor feedback is designed to reinforce the procedural steps of patient assessment. In the HF simulations, however, the preceptors focus on difference. Their feedback is situational, often aimed at instances rather than facts and rules, and is sometimes contradictory. Their feedback is tailored far more to Dreyfus' (2001) categories of proficiency

and expertise than the instructors' feedback. Different preceptors attending to chest pain calls give feedback on different aspects of the call—one focuses on the process of differential diagnosis ("You have to rule things out") while another discusses how to function on a call involving first responders and advanced care paramedics. Where instructor feedback is based on predetermined instructional goals, tied to the mastery, sequencing, and decision making, preceptor feedback tends towards the situational and qualitative questions of how to do things better in specific situations. Preceptor advice is usually situated in "calls like this" rather than as generic, context-independent rules and principles.

Thus, the preceptors appear to be coaching the students on how to read the environment they are in, to look for what is important, and how to *discern* what is foreground from background in *this* situation-in-the-moment. As well, the preceptors actively encourage the students to adapt their previously learned skills and procedures to meet the needs of the present situation. The students are already technically competent; however, the preceptors constantly remind the students that field practice is about alternatives and adaptation. For example, a Kelowna preceptor provided an impromptu skill station on how to apply hard collars on patients who are in awkward positions on uneven ground, while a Kelowna preceptor led a discussion on how to manage multiple competing priorities on a multi-trauma patient. Both cases extended and modified procedures learned in the curriculum based on the situation at hand.

In contrast to the drive for consistency in technical competence, ecological perspectives view the emergence of clinical competence as an ever-increasing set of potential responses to new situations; its development is a process of expansion. Images and metaphors of growth, such as the increasing bifurcation of the branches of a tree, represent the increasing possibilities of clinical competence and expertise (Davis, 2004). Deleuze and Guatarri (1987) employed the

metaphor of a rhizome, where differing strands or shoots intertwine in an ever-expanding network of relationships between experiences see (see Figure 27). From this perspective, learning becomes an outward-looking process that opens possibilities for future action. Learning is still seen as progressive, but not as additive, nor predictable, nor linear.

Fostering Discernment

Simply creating a rich environment does not necessarily foster discernment nor promote the development of clinical competence and clinical judgment. The explicit goal of the HF module was to create a dynamic system in which learners could have the opportunity to engage with a rich, active environment. When confronted with this novel environment, the students responded as practitioners often react: they did what normally worked for them (Schön, 1987). They continued to rely on verbal information, they quickly formed diagnostic impressions and made decisions based on the calls in their databank, and they followed the habits of practice they had established in their classroom simulations.

Flyvberg (2001) noted two phases in the Dreyfus' (2001) model of skill acquisition. The initial phase (novice, advanced beginner, and competent performer) led towards consistent, context-independent performance, what is defined in this study as technical competence. An advanced beginner in this scheme looks for known situational aspects (e.g., key features or signs and symptoms) and develops a plan of action by application of principles or maxims (Dreyfus, 2001). But, Flyvberg noted, the second phase of the model requires learners to progress beyond the use of key features and principles, and to explore the unique aspects of specific cases. Proficiency and expertise involve exploring nuance and discerning the salience of features in a case, then deliberately committing to a choice between multiple acceptable options (Dreyfus, 2001). The goal of expertise is not to see what is similar in a situation—it is, rather, to look for

and recognize what is different in a specific case, to distinguish, for example, between competing possible causes of a patient's chest pain. This open-ended process of decision making based on a variety of contextual factors is referred to in this study as clinical judgment. And a critical element of expertise and clinical judgment, then, is discernment, the ability to enter a dynamic environment, selectively engage with salient aspects of that environment, and determine what is important in *this case*. Discernment is more than looking for key features of a disease or injury; it involves expanding one's diagnostic horizon to look at the nested set of factors and features that are present in any particular situation.

The fostering of discernment is complicated by the lack of language with which to describe it. Practitioners use language differently than novices, and the context and nuance of a situation is often lost in description (Schön, 1987). Preceptors, in Schön's (1987) terms, "know more than they can say" (p. 22). Schön (1983) noted that much of the practice of a profession is hidden in its performance in ways that do not lend themselves well to description. Thus, effectively fostering of discernment and expertise requires coaching rather than instruction. The preceptors recognize the need for discernment, constantly encouraging learners to expand their awareness of the situation, prompting them for clues that are important in *this instance*, requiring them to interpret the data they collect in their patient assessment procedures. The preceptor is highlighting a new situation—a new combination of contextual features and desired responses, expanding the learner's range of possible set of actions.

Clinical competence and clinical judgment as complex phenomenon. Clinical competence, as with clinical judgment, *requires* rather than isolates context. Flyvberg (2001) drew on the Dreyfus (2001) model of skill acquisition to further emphasize inseparability of context and judgment. Context is always already involved in decision making and cannot be

isolated and treated as a mere "factor." The development of clinical judgment is a function of the learner and the environment together. As Flyvberg noted, judgment requires attention to the unique and salient features of a particular case. The enactivist concept of structural coupling (Maturana & Varella, 1987) involves the relationship of learner, context, and experience together fostering emergence of responses that would not be possible by any of its elements individually. Davis and Sumara (2006) noted that emergence is the development of new and unique responses within novel situations, rather than the development of a consistent and repeatable response in predictable contexts. Thus, the development of clinical judgment is a function of both the learner *and* the environment, and one cannot prescribe and provide, in advance, a set of context-independent criteria by which learners could assess and monitor their future performance (in relation to clinical judgment).

From this perspective, the development of clinical judgment is more than the acquisition of a skill or the development of an ability that transfers across situations. It is, rather, an emergent process that is both idiosyncratic and situational. Klein (1997) posed situational awareness as a recognition-*primed* process, not merely a process of recognition. A practitioner may display clinical judgment in one situation but not necessarily transfer that performance across domains or contexts. Thus, emergence of clinical judgment is personal and unpredictable, a process that requires multiple engagements of the learner and context. Each instance, each case, each new experience that the practitioner encounters adds new situations and new potential responses for future recognition and adaptation. Clinical judgment emerges over time as a way of approaching, attending, acting, and interacting with the dynamic environment of field practice (see Figure 28).

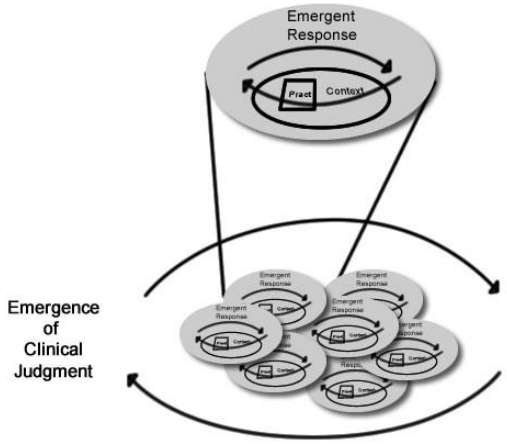

Figure 28. Emergence of clinical judgment from multiple encounters over time.

The emergence of clinical judgment is further embedded in the community of practice within which the practitioner is working. The practitioners' decisions and responses are distinguished *as* clinical judgment by their recognition and congruence with acceptable performance within that community. Recall Davis and Sumara's (2006) view of learning as the ongoing negotiation of the boundary between personal understanding and acceptable practice within a discipline. Practitioners develop clinical judgment as they learn to recognize and respond to situations in a way acknowledged by the broader community.

Thus, the development of clinical judgment is not *solely* situated within the individual. Knowledge, learning, and the development of clinical judgment are all social constructs whose conceptions and definitions are mutually constitutive. Davis and Sumara (2001) posed learning in the workplace as a function of the overall system, not any of its individual constituents. Clinical judgment can occur only in the interactions between individual and context. Those interactions can only be recognized as clinical judgment by the community of practice or context of disciplinary practice.

Summary

The learners in this study entered dynamic simulation environments, populated with diverse complex actors and features that interacted in unpredictable ways. Preceptors and students engaged with these environments in different ways. Preceptors were more discerning in the features and aspects of the environments. Their situational, difficult-to-categorize, and always qualified feedback was a form of coaching that sought to develop a process of discernment in their students. This raises the question of how the preceptors and experienced practitioners chose what to attend to. Schön (1983) referred to the process of naming and framing as an expert's tacit knowledge showing itself in performance.

Ambulance calls, whether in simulation, in the practicum environment, or in field practice, are *all* created experiences, shaped by participants' previous experiences, reflections, and actions. Instructors and preceptors mirror their fields of practice. Instructors function within closed curricular structures, seeking and enforcing the consistency of technical competence based on *right* and *wrong* answers. However, evaluation of learning and determinations of *right* and *wrong* performance are problematic in situated learning and complexivist perspectives (Davis & Sumara, 2006; Fenwick, 2003). Preceptors function in a more dynamic, unpredictable, and unknown environment in which they must construct their own understanding of the situation before developing a relevant and clinically competent response.

The current paramedic curriculum structure, and the assumptions that underlie the Practice Ladder, conceive of the practicum and field environments as extensions of the classroom, with HFS as a potential bridge between these environments. Yet, there are fundamental differences in the way that practitioners (instructors and preceptors) in these two domains conceive of learning and determine what constitutes acceptable practice. These different

ways of knowing are discussed next.

The Dilemma of Under-Theorized Practices: The Pedagogies of Simulation and Different Ways of Knowing

The central dilemma prompting this study is why, despite considerable expense and effort, HF simulation-based learning environments are still not seen by health practitioners and educators as replacements for the practicum environment. In Chapter 1, I asked in what ways the roles, expectations, teaching and learning activities, and assessment methods differ between these two environments. This section addresses this question through two discussions: pedagogies of simulation and different ways of knowing.

Pedagogies of Simulation

Simulation literature often presents simulation as a distinct instructional strategy, and theorists and writers call for a richer understanding of the pedagogy of simulation (see, for example, Ericsson, 2007; Essington, 2010). The findings in this study, however, indicate that there are multiple *pedagogies of simulation* where varied activities support different types of learning goals.

As noted earlier in this chapter, the concept of learning as a progressive acquisition of increasingly complicated procedural chains is deeply embedded in curriculum models and documents that inform paramedic education. The structure and use of the JIBC Practice Ladder and the categories of the Dreyfus (2001) model of skill acquisition both imply a hierarchy of practice learning activities. The *NOCP*'s (PAC, 2001) performance domains are explicitly presented as a hierarchy, with learning in the clinical and practicum environments seen as extensions of simulation and academic activities. As well, the *NOCP* employs the same language, structure, criteria, and definition of competence across its performance domains. The

implication is that a common pedagogy sits underneath these models and that each level or domain is an extension of previous environments and is a subset of an overall system.

Yet, while the simulation learning environments in this study shared many characteristics, they were, nevertheless, fundamentally different domains. In Chapter 4, I presented a descriptive analysis that outlined distinct differences in structure, pedagogical characteristics, and aspects of fidelity associated with each type of simulation.

A further analysis of the activities in the JIBC Practice Ladder showed that different simulation activities called upon different learning activities, employing varied modes and methods of evaluation which, in turn, emerged from different epistemological, ontological, and theoretical frameworks. Table 18 extends the characteristics of the Practice Ladder to include learning goals, instructional strategies, nature of assessment, and underlying epistemological, ontological, and learning theory. For examples, Core Skill drills call upon mastery learning methods and evaluate learners' performance against observable criteria as listed on a checklist. By contrast, procedural Classic Case simulations focus on integration of multiple procedures and collaborative discussion set within a situative learning framework. The practicum environment is a social environment of shared activity, situated and negotiated evaluation, with coaching and mentoring more characteristic of a community of practice approach.

Table 18. JIBC Practice Ladder analysis

Practice Activity	Component	Focus	Learning Goal	Evaluation	Primary Learning Method	Instructional role	Nature of Assessment	Ontology	Epistemology	Underlying Learning Theory
Practicum	Calls within shifts	Experience	Proficiency	Reflection, feedback	Reflection	Individual coaching and mentoring Post-call/ Post- shift critique	Better answers within experiential framework set in overall discussion of best practice	Constructionist	Interpretivist	Social constructivist, community of practice
Clinical	Patient encounters	Exposure, Practice	Recognition, Application	Assessment, feedback	Collaborative feedback	Individual coaching	"Right" answers within contextual framework	Constructionist / Realist	Objectivist /Interpretivist	Mastery / Situated Learning
Immersive Simulation	Calls within context	Problem-solving	Adaptation	Collaborative discussion & acceptable performance based on best practice	Collaborative discussion Reflection	Peer-based practice with post-exercise critique	Better answers based on best practice Analysis Synthesis?	Realist/ Constructionist	Interpretivist	Situated Learning
Procedural Simulation	Calls	Differential Diagnosis, Decision making	Integration	Acc. / Unacc. based on procedural criteria and mastery checklists	Structured feedback Criteria-based checklists	Peer-based practice with coaching Post-call critique	"Right" answers within contextual framework, concrete rules with contextual interpretation	Realist / Constructionist	Objectivist /Interpretivist	Cognitivism
Drills/OSCE	Procedures	Procedures	Sequencing	Acc. / Unacc. against mastery checklists	Structured feedback Criteria-based checklists	Guided practice coaching	"Right" answers, context dependent	Realist	Objectivist /Interpretivist	Cognitivism Mastery
Skill Station	Skills	Skill performance	Mastery	Acc. / Unacc. Performance against mastery checklists	Mastery level checklists	Guided Practice	"Right" answers, context independent	Realist	Objectivist	Mastery

Thus, specific simulation activities call upon different theories of learning, different conceptions of *right* and *wrong*, and different instructional and evaluative approaches. Current simulation environments and the practicum are radically and fundamentally different learning spaces.

Different Ways of Knowing: The Ontological Divide

Throughout this study, a consistent theme contrasts the differing role, pedagogical activities, and interpretive approach taken by instructors and preceptors. These practitioners represent two distinct communities of practice that employ different ways of knowing.

Wenger (as cited in Fenwick, 2003) posed communities of practice as groups joined "by the sustained pursuit of a shared enterprise" (p. 25) through engagement with "the community (with its history, assumptions and cultural values, rules, and patterns of relationship), the tools at hand (including objectives, technology, languages, and images), and the moment's activity (its purposes, norms, and practical challenges)" (Wenger as cited in Fenwick, 2003, p. 25).

Paramedic education, like many forms of applied or professional education, focuses on preparing learners for entry-to-practice. The PCP program was designed using classic instructional systems design processes and methodology to guide learners efficiently and effectively towards technically competent practice. A key metric for accreditation of paramedic programs is success rate of graduates in certification and licensing examinations (Canadian Medical Association, 2007b). Core content and evaluative criteria from the program are drawn from the *NOCP* (PAC, 2001). Instructors are drawn from the ranks of practicing paramedics, further strengthening the link to the field. Thus, in intent, design, and execution, the existing program sees the classroom and the field (and by extension, simulations and the practicum) as linked steps in the progression of the learner towards participation within the community of EMS

practitioners. Yet, throughout this study, I have found contrasting practices, contradictory views, and significantly different forms of engagement between instructors and preceptors.

The opening anecdote for this dissertation posed the learners' experience of moving from classroom to practicum as a gap, a chasm separating the comfort and consistency of technical competence from the complexity, noise, and unpredictability of clinical competence in field practice. I have framed technical competence in this study as consistent, timely, uncoached, and context-independent performance, what Schön (1983) referred to as the application of instrumental solutions to known problems. These definitions rest on objectivist and realist views. By contrast, clinical competence is the ability to develop appropriate and adequate responses to dynamic problems that may resemble prior cases, but are yet distinct and unique. This framing calls upon pragmatic, subjectivist, and interpretivist perspectives. The difference between these two views of competence is more than mere semantics; it is an ontological divide between two fundamentally different world views, each with distinct ways of defining knowledge, acknowledging truth, and assessing performance.

Foucault (1980) warned of the negative effects inherent in totalizing theories and discourses. While acknowledging the utility of comprehensive theories (which, in this context, includes theories of practice *and* theories of learning), he noted that such theories hinder alternate ways of knowing. He described the concept of subjugated knowledge as blocks of knowledge that are hidden away from dominant knowledge and power structures, or as local ways of knowing that are deemed impractical or unworthy. He described how the insurrection of these local, subjugated blocks of knowledge reveal cracks and fissures in the bedrock of dominant theories. Foucault's warning speaks directly to the differences between technical and clinical competence.

Instructors and preceptors have different ways of knowing. Paramedic instructors, generally drawn from the ranks of active practitioners, must, upon entering the academy, rebuild the knowledge and skills base from which their practice emerged. Guided by instructional design processes, they analyze and organize their understanding of their domain of practice into hierarchical, sequenced content in the form of courses, textbooks, study guides, and learning activities. They create lessons and build simulations designed to help their learners acquire the *skills*, *knowledge*, and *judgment* required to function as field practitioners. And they develop evaluations built from blueprints created from this analysis. They "fill in the gaps" that may have emerged in their own skill and knowledge base in preparation for their teaching roles. This way of organizing the "stuff" of practice becomes institutionalized, in effect, as a dominant knowledge that is enforced through assessment, feedback, evaluation, and certification. The language of the instructor is the language of "doing things right": the language of technical competence. In Foucault's (1980) frame, the instructors strive for a totalizing theory of practice which is imposed on recruits.

Practitioners (and hence preceptors) *know* in far more subjective and relational ways. As paramedics enter practice, they gain experience, which allows them to see calls as episodes rather than models. They learn to recognize patterns and situations, and to take shortcuts that streamline and simplify their work. Their approach, built on the theory of practice they learned in their own training, evolves, shaped by context and coincidence. They learn what types of calls are common in their areas, how to interact with the crews and allied services around them, what works for them and what does not. Over time, their training recedes to background, evolving into the intuitive, experiential way of understanding practice, interpreting experience, and guiding activity that forms the tacit knowledge base of a profession (Lave & Wenger, 1991; Schön,

1987). In Foucault's (1980) frame, experienced practitioners develop a subjective, locally valid, personal theory of practicing within their own contexts. "How we do things in the field" and "my way of doing things" (the language of clinical competence) is the language of "doing the right thing" in *this* situation.

Instructors function in an inherently closed system in which correct performance is explicitly defined in goals, objectives, and curricular documents. Field practice, by contrast, is a more social environment in which practitioners are not judged on the correctness of their actions so much as the adequacy and fit of those actions to the demands at hand (Fenwick, 2003).

The current curriculum structure views the practicum as an extension of the simulation environment. The program uses the same mastery checklists and evaluation criteria to assess performance in simulations and in field settings. Similarly, documents such as the *NOCP* (PAC, 2001) fail to distinguish between the expectations of practitioners in simulation and practicum domains. These evaluation criteria and processes, with their focus on consistency and technical competence, are imposed on the practicum setting and clash with the expectations and more subjective and experiential evaluative sensibilities of preceptors and practitioners. And the students are caught between these very different sets of expectations.

Thus, the relationship between these overlapping, but essentially different learning domains, is a form of nestedness. Each represents a distinct community of practice. As Lave and Wenger (1991) pointed out, a school community is different than the community of practitioners for which it prepares learners. From the student's perspective, each domain of learning is a complex environment, with its own values, norms, and patterns of practice. Yet each shares much in the form of common language, concepts, and practices. The interactive relationship between the two domains is further entwined by the way each constitutes and renews the other. As

students move from class to field practice, they become newcomers in the community of field practitioners, helping, over time, to shape and modify its practices (Lave & Wenger, 1991). As they move into full participation in the field community, some members return to the institution as instructors, bringing current practices, norms, and values from field practice to influence the community of practice within the school. With time and experience, as the new instructors become full practitioners within the school's community, their views become institutionalized within an ever-evolving curriculum. Thus, the two communities of practice can be seen themselves as complex entities whose interactions elicit change in each other and result in the emergence of systemic responses within a broader context.

Summary

In this discussion, I have argued that the differences between the varied simulation and practicum environments involve more than simply the physiological and environmental fidelity of the simulation. Simulation environments can, and are, constructed to meet a variety of learning goals. These goals emphasize different aspects of paramedic practice. In this sense, then, it is inappropriate to talk about *the pedagogy* of simulation. Rather, different types of practice-learning outcomes require the design of simulation environments with different functional requirements and blends of fidelity. Instructional design models such as the Practice Ladder are a way of conceiving *the pedagogies* of simulation as ways of creating different kinds of practice learning environments, in which learners can master skills, integrate procedures, encounter prototypes, and foster discernment and judgment.

Current HF simulation environments are often conceived and constructed as extensions of existing simulation structures. Yet, as noted above, the expectations of these environments are fundamentally different than those in the practicum environment. A HF simulation environment

that seeks to replace or supplement the practicum environment will call upon different functional requirements and emphasize different blends of fidelity. The following section extends this discussion through an exploration of the concept of fidelity.

Taken for Granted Assumptions: Fidelity as a Complex Phenomenon

One of the intriguing findings of this study is that simply increasing the fidelity of a simulation environment does not necessarily lead to higher order learning outcomes. Indeed, labels such as "high fidelity" and "low fidelity," or even "*the* fidelity" of a simulation, are often misleading. Effective simulation-based learning environments call upon situational blends of fidelity to meet varied learning outcomes.

Within simulation and medical education literature, fidelity is often posed as a comprehensive construct indicating the degree to which a given simulation resembles real experiences (Gaba, 2004; Garrett, et al., 2007; Norman et al., 2012). The implication is that higher order learning outcomes require a higher fidelity simulation environment (Beaubien & Baker, 2004; Norman et al., 2012). As developed in Chapter 2, I posed fidelity in this study as a complex construct—a series of dynamic relationships involving selected elements of a simulation environment. This conception emphasized the constructed character of fidelity (it *is* only in the eyes of the creator and those who experience it), the subjectiveness of its experience, and its experiential nature. The simulations in this study represented several distinct types of practice learning situations, each of which called for a differing blend of fidelity to help support their particular learning goals.

Blends of Fidelity

Simulation and fidelity are often presented in medical education literature as singular terms. Yet, in this study, I found that the differing pedagogic goals in each course led to the

development of simulations with substantially different learning outcomes, structures, and blends of fidelity. The Core Skills lesson focused on development of relatively context-free skills and procedures. While the overall fidelity of the simulation was low (particularly the environmental, physiological, and role aspects), the simulations highlighted key features of the conditions that were being practiced. And, surprisingly, the procedural fidelity was very high. Similarly, the Classic Case simulations had fairly low physiological and environmental fidelity. These calls provided prototypical experiences for the learners, and thus the patient information was richer and more complex. Learners practiced acquiring specific types of information (e.g., signs and symptoms) relevant to the particular case, even though they tended to obtain that information by verbal means. The scenarios here were designed to practice gathering the data and making decisions, not necessarily exploring nuances in diagnosis; in other words, to practice the steps of clinical reasoning, if not its process. The HF simulations, in contrast, specifically increased the environmental, role, and interpersonal aspects of fidelity. This was in keeping with the goal of creating a rich environment for the learners to engage in the nonpatient care aspects of performing an ambulance call. Thus, the patient presentations were more ambiguous and less critical to the pedagogic intent of the calls. Intriguingly, increasing the overall authenticity of the simulations by choosing calls with a range of acuity and emphasizing the social and environmental aspects decreased the requirements for physiologic and procedural fidelity.

Simulation literature has tended to define learning environments as having high or low fidelity (see, for example, Norman et al., 2012; Qayumi et al., 2012). However, I found that the relationships between different aspects of fidelity in this study were neither linear, hierarchical, nor progressive. As noted above, even low fidelity skill station and drill activities were designed to highlight specific aspects of a situation and allow for accurate and authentic practice of

specific procedures. Similarly, various elements of HF simulations were still verbalized, time-compressed, or left out of the simulations. These findings suggest that the fidelity of a simulation is better conceived as a blend of contextual factors than as a single, comprehensive label.

Not only is the overall fidelity of a simulation a complex phenomenon, but its constituent elements are also dynamic and unpredictably interrelated. The procedural fidelity of all simulations was generally high, particularly when considered as whole experiences, although *all* simulations required verbalization, miming, or mirroring of some aspects of the call. While the Core Skills simulations had low physiological, environmental, and interpersonal fidelity, almost all assessment and treatment were performed in an authentic manner using real equipment and procedures. While the procedural fidelity was generally higher in HF simulations, both the number and type of mimed or verbalized tasks varied from call to call. For example, the crews in the HF simulations were not able to simulate loading and transporting patients to hospital, and thus, even in the HFS environment, this component of the call was time compressed and verbalized.

The overall fidelity of the experiences was enhanced in the HF simulations through the use of actors and HF mannequins. Yet, even in this environment, participants were required to verbalize and mime some assessment and treatment procedures, such as obtaining physical findings (e.g., breath sounds) in healthy actors, or the presence of track marks on a mannequin in a cardiac arrest call. Participants used several strategies to mimic real procedures, including mirroring and miming. These strategies cued both partners and call managers as to what the participants were doing. The participants also used these strategies to practice and reinforce the performance of tasks within the overall context of the call. For the most part, participants employed these strategies without disrupting the flow of the calls.

Discussion

The findings in this study support the conception of fidelity as a set of dynamic relationships that constitute a situation—a complex entity consisting of nested dynamic elements. The selection of facets of fidelity chosen to develop the HF simulations in this study supported the pedagogical intent of the session: creating a rich, dynamic environment that allowed participants to explore the development of clinical judgment. Both students and preceptors commented that the aspects of fidelity that were brought to the forefront in these simulations had positive effects on their experience and on what they learned from that experience. The findings of the study also support the position that fidelity is best considered a blend of factors that should be matched to the desired learning outcome. It is difficult to talk about *the* fidelity of a simulation. Each simulation, from simple drills to HF simulations, involved a variable mix of fidelity to different aspects of the scenario.

This implies that simply raising the fidelity of a simulation will not necessarily lead to increased learning outcomes. Rather, for each simulation setting, the particular factors to be considered, and the degree of fidelity or method of representing those factors should be selected to meet the learning needs. Nor does creating a higher fidelity environment necessarily lead to greater engagement with that environment by the participants. In this study, the students moved from a known environment (classroom simulations) into a dynamic environment with different ways of presenting and acquiring information. The preceptors and the ACP students (who had considerable street experience) were able to recognize the environmental cues and take advantage of the richer HFS environment. The students, however, had a more variable experience. While the students were aware of the environment and, in subsequent focus group interviews recognized the value of it, they nonetheless were unsure how to interact and gather

information when entering this new environment. The students required ongoing prompting to interact with other responders and bystanders. They sometimes struggled to obtain information from patients who did not offer organized stories. And the calls that involved low acuity, high interpersonal interaction often seemed to cause the most confusion in the students.

Summary

Fostering the development of clinical competence and clinical judgment requires situational blends of fidelity involving selective elements of the learning situation. However, increasing the overall fidelity of a simulation alone is insufficient to foster the development of clinical judgment. Simulation environments that foster clinical competence and clinical judgment require more than increased physiological and environmental fidelity. Effective learning environments require situational blends of fidelity, acknowledging the need for interpersonal and role fidelity, and employ instructional strategies and evaluative structures that more closely resemble how preceptors work within the practicum environment.

Unchallenged Assumptions: Curriculum as a Potential Space of Guided Exploration

Current paramedic programs are built on unchallenged assumptions of learning based primarily on behaviourist and cognitivist approaches. The program effectively develops technical competence, but learners struggle in the transition to the dynamic, socially negotiated expectations and experience of field practice. As learners move from the confines of the classroom to the community of field practice, they encounter a much broader set of contexts and considerations and a far more dynamic decision-making milieu. Professional practice far exceeds the prescriptions of competency documents, and a curriculum which seeks to foster proficiency, expertise, and clinical judgment must be open to process of adaptation and negotiation and the expectations of overlapping communities of practice. The concept of curriculum, like many of

the concepts presented in this study, evolves, driven by changes in the underlying epistemological and ontological presuppositions from which educators and practitioners function.

Curriculum conceived from the perspective of classic instructional systems design concepts focuses on the artifacts and products that structure and support instruction (see, for example, Dick & Carey, 1985). The goal of curriculum design is to develop a "carefully conceived instructional strategy" (Dick & Carey, 1985, p. iii) which leads students towards developing "consistency between the various components" (Dick & Carey, 1985, p. ix) of their learning. Curriculum from this perspective highlights the instructional components of the learning process, while recognizing that learners may engage with the elements of the curriculum differently. However, this view conceives of curriculum as a closed system in which all paths lead to the same place (Romiszowski, 1981). The language of curriculum from these perspectives draws heavily on images of construction and geometry (Davis & Sumara, 2006).

By contrast, Pinar (2004) called upon views of curriculum as a process or journey—as *curare*—the course that one runs. Mirroring trends in educational theory in the latter half of the twentieth century, these views focus on the process of learning over the structures of instruction and emphasize the learner's role in the experience. Constructivist conceptions similarly focus explicitly on the idiosyncratic processes by which learners incorporate new experiences into existing memory structures. Not only do these discourses focus on the individual, but taken to radical extremes, they pose teaching as an irrelevant activity (Davis & Sumara, 2006). Davis and Sumara (2006) noted that metaphors from these perspectives tend to rely on body-based metaphors such as personal journey, bodies of knowledge, body politic, etc.

Jonassen (2003) compared and contrasted these two paradigms by noting "constructivist

views of learning are focused more on understanding and meaning making than knowledge, knowledge construction rather than instruction, and social interactions rather than behavior" (p. 6). While each provides significant insight into the functions, respectively, of learning and teaching, they are, at the same time, limiting in helping to understand the emergence of complex phenomena such as clinical judgment within a community of practice. Instruction-focused paradigms do not sufficiently allow for the open-endedness and idiosyncrasy of professional practice, while learner-centred perspectives struggle to acknowledge the importance of professional boundaries and common practices.

In the following discussion, I pose a reconception of paramedic curriculum that focuses on the relationships between teaching and learning in professional settings as dynamically intertwined processes that themselves are embedded or nested in a series of other complex phenomena. Curriculum involves more than structures and experience, more than instruction or learning. Teaching necessarily teaches from some *place*, and learning is always learning about some *thing*. Neither process can be separated from its context. And that context, for this study, is formal education set within a disciplinary community of practice. Curriculum involves the interplay of the experience of the learner and the intent of the instructor within a disciplinary context.

Thus, I pose curriculum as a potential space of guided exploration and growth. The following discussion explores three facets of this conception: disciplinary boundaries, instructional/institutional structures, and practitioner growth.

Conception of curriculum as a potential space acknowledges learning in professional contexts as a place of interaction involving multiple complex phenomena. The space is potential in that it is necessarily bounded. The boundaries may be firmly set (for example, as outlined

through legislated scope of practice or documents such as the *NOCP* [PAC, 2001]), or they may be more porous (as when new practitioners enter practice in a specific jurisdiction). But there are boundaries. The space is potential in that it may be explored lightly or in depth. Different curricula, and participants interacting with that curricula, may have varied goals and interests.

Curriculum in professional settings also involves instructional intent and institutional structures—learning is shaped and guided through a program's conceptual framework and activities of learning. This guidance is formed both through the institutional context and the perspectives and desires of the instructors (and/or instructional designers). The institutional context of the curriculum, including, for example, its reason, rationale, enabling and bounding constraints, serves to support what, where, when, and how learners engage with and fill the potential space of the curriculum.

Finally, learning, the emergence of increasingly nuanced responses to novel situations, occurs for and amongst the individual participants within the learning environment of the curriculum. While this learning occurs organically and idiosyncratically, it is also enabled and constrained by the potential space and instructional supports it emerges from. Learning is neither linear nor stable, but rather a continuous calling forth of potential responses to novel situations, calling upon blends of previous experience, disciplinary knowledge, acquired and adapted skills, and anticipatory action, focused and framed by instructional activities, shaped through interaction with the larger community of the discipline.

This conception of curriculum as a potential space of guided exploration and growth calls for different metaphors. Davis and Sumara (2006) noted that complexivist sensibilities are drawn to metaphors of ecosystems and codetermined choreographies. Such metaphors might pose the learning environment as the evolution of a dance or the creation of an instructional trellis which

provides overall structure and shape to the unique growth of each learner within the potential space suggested by the trellis. Another metaphor could include throwing rocks in a river, creating multiple potential pathways through the ever-changing flow of experience, while allowing learners to pick and choose their ways. Romiszowski (1981) called upon metaphors of fenced pathways and open fields to distinguish between training (creating discrete pathways to known outcomes) and education (where one wanders freely, exploring a domain a domain or discipline). Sitting between these two extremes, Romiszowski posed the map as a metaphor for curriculum design, a way to lay down intentionality and direction to those who need it over an ecosystem that calls out for free exploration.

These metaphors reframe learning, teaching, and the development of professional expertise as ongoing processes that are not time and place bound. They acknowledge that instruction (and teaching) are efforts to direct, guide, and influence the experience of learners, while recognizing that the outcomes of learning are dependent on the interplay of multiple factors. The development of technical competence provides the structure from which practitioners can grow and explore their discipline, developing clinical competence and clinical judgment within the bounds of the profession.

Within the context of paramedic practice, competency profiles and curricular documents provide structure and shape to the experience of learners. But the practice of paramedicine is far richer than an analysis or listing of its constituent tasks and competencies. Field practice, in practice, involves the interaction of regulatory and legislative boundaries, operational policy and procedure, and local history and practice. In addition, each call is an intersection of these formal boundaries with an even more dynamic blend of factors that includes the nature of the call itself, the patient, the preferences and interplay between partners on an ambulance crew, other

responders, bystanders and family at a scene, and the health professionals at receiving hospitals. Thus, a conception of curriculum as an open, dynamic system better supports the development of expertise and clinical judgment.

The Practical Problem: Fostering Emergence of Learning in HF Simulation-Based Learning Environments

This section returns to the practical problem: the presumption that HFS can foster the development of clinical judgment and reduce reliance on the practicum environment. The findings in this study suggest that learners moving from existing paramedic stimulations to the practicum setting encounter differing roles, expectations, instructional strategies and evaluative approaches. These learning environments call upon fundamentally different epistemological and ontological concepts of knowledge, competence, and learning. Thus, simulation environments that might foster the emergence of outcomes such as clinical competence and clinical judgment must move beyond simply increasing physiological and procedural fidelity, and must more closely resemble the noise, unpredictability, and socially negotiated experience of field practice.

Davis and Sumara (2006) brought the concepts and language of complexity to the study of curriculum. In posing learning as a process of emergence within complex open systems, they opened new ways of looking at the relationships and interactions that function within dynamic learning environments. They proposed a set of conditions that support the emergence of learning in complex environments. These conditions related characteristics of complex phenomena to the learning environment in pairs of contrasting functions: redundancy and internal diversity, randomness and coherence, and distributed control and neighbouring interactions.

Redundancy and Internal Diversity

Complex phenomena are open systems that function best far from equilibrium (Davis &

Sumara, 2006). Success in a complex system is less about consistency than in opening up a wide range of potential responses to unknown and dynamic situations. Diversity of elements allows a system to develop multiple sets of responses to emergent and unpredictable circumstances. Internal redundancy ensures that a system can participate in complex co-activity, with "common language, similar social status of members, shared responsibilities" (Davis & Sumara, 2006, p. 138) that enable relationships, cooperation, and collaborative action. These shared social redundancies form the tacit background that Lave and Wenger (1991) posed as the workings of a community of practice.

The HF simulations in this study created both internal diversity and redundancy by increasing role and social/cultural fidelity. In classroom simulations, the attendant assumed the key role and other participants were constrained in their ability to function as they would in a field setting. This reduced both the internal diversity (other participants were not allowed to offer differing positions or interpretations) and redundancy (other participants could not provide support or validation) of the simulation environment. The diversity of classroom simulations was further limited by having instructors or students role play bystanders and other responder roles. The activities of these other responders was both scripted and then interpreted by participants who had the same background as the learner.

Increasing the role, interpersonal, social, and cultural fidelity of the HF environment provided a richer contextual environment for the learners to engage with. In contrast to the classroom environment, with its constrained roles, carefully crafted prototypical incident, and predetermined outcomes and expectations for performance, learners entering these HF simulations encountered and interacted with numerous people and situations, each of whom acted, interacted, and were acted upon by the others. The learners were forced to consider and

practice clinical reasoning within a more complex and dynamic milieu. They obtained advice, coaching, feedback, and mentoring on varying approaches to patient assessment and patient care. Preceptors and other responders modeled acceptable alternatives that differed from the consistent approaches learners encountered in their course material and classroom simulations. Interactions such as the end-of-simulation discussions with the Vernon triage nurse provided opportunities for the learners to see how the actions they took and information they gained were interpreted differently by related health care providers. Participation in layered response calls with life guards, police, fire fighters, and advanced care paramedics emphasized the differences in how each service or discipline interpreted and enacted such common activities as performing CPR.

Much of the discussion and feedback in these simulations was situational and aimed at helping learners focus on the important aspects of situations that they were in (e.g., fostering discernment). In addition, the wide variety of perspectives, from diverse disciplines and backgrounds, added further perspective and understanding of the situatedness of performance in the field. The learners were able to see how practitioners from related disciplines interpreted the same environments, and how their needs and actions differed from the paramedic perspective. Thus learners were exposed to divergent views on attending to and interpreting the world and multiple constructions of what constitutes acceptable practice. The learners were able to see how different practitioners set, articulate, and defend the boundaries of their personal approach to practice; how the community they were entering views and describes acceptable practice; and by what criteria judgment is exercised. More importantly, the learners were able to receive feedback from the varied participants on their own awareness, choices, and interactions, their own developing clinical judgment.

Randomness and Coherence

The current curriculum structure is ironically structured as a carefully sequenced set of experiences designed to develop learners' ability to function in the decidedly dynamic context of field practice. The curriculum is designed as a closed system and the simulations are selected and developed to provide prototypical examples of common situations. Yet the field environment that graduates enter is an open system: unstructured, less predictable, requiring discernment and interpretation to create meaning.

Davis and Sumara (2006) noted that open systems have ambiguous boundaries that exchange matter and information with the environment around them. These complex systems, however, require enabling constraints to function effectively. Complex systems are rule bound, with imposed constraints that may arise from the context of the phenomenon, its structure, or its co-implicated actions with other phenomena. The enabling constraints are critical for the entity to remain stable. But, Davis and Sumara (2006) pointed out, these rules are proscriptive, rather than prescriptive (*ought* rather than *will/will not* rules) that leave open, rather than constrain, the possibilities for action. They pose *randomness* and *coherence* as balancing forces that allow complex phenomena to interact in meaningful ways and develop an expanding range of potential responses to new situations. Complex phenomena require sufficient coherence to orient agents' actions and sufficient randomness to allow for flexible and varied responses.

The HF simulations in this study were set in the practicum environment, which allowed for a rebalancing of the expectations and experiences of the learners in terms of randomness and coherence. The current curriculum guides learners through an efficient and effective pathway of learning experiences designed to expose them to the range of injuries and conditions that they must be able to recognize and treat. As noted in this study, this overt structuring of the students'

experiences may be a limiting factor in developing clinical judgment. The students in this study entered the HF environment with a strong grasp of their diagnostic procedures and sequencing. Yet, when confronted with novel situations, they sometimes struggled to use their patient assessment procedures *as a diagnostic process*, often quickly moving to inappropriate diagnoses. This mirrors the experience of field preceptors who noted that students entering the practicum often stumble on encountering the open-endedness and randomness of the field environment. In addition, the students suddenly encountered a setting in which they were required to adapt their previously learned protocols and treatment options to meet local practice, expectations of their partners, and hospital staff with differing perspectives on effective prehospital practice. Students moved from a carefully sequenced and controlled environment, with clearly constrained roles and predetermined expectations, to an environment in which the enabling constraints of randomness and coherence function in a radically different balance.

The HFS module rebalanced these constraints by increasing the randomness of both call types and acuity while allowing preceptors to provide coherence through functioning as coparticipants and coaches in the calls. The HF simulations in this study were designed as a bridge between the end-of-class exams and the students' field practicum. The explicit goal was to allow learners to experience the diversity and open-endedness of the environment they were moving to. The preceptors entered the day with the intention of helping students transition from the classroom to the practicum performance domains; to encounter, in a known way, a curricular switch rather than experience, unprepared, the move to the field setting.

Coherence, in the context of paramedic practice, may be thought of as the process of interpreting the environment and discerning what features and information are most important to *this call*. The preceptors provided coherence by prompting, articulating, and demonstrating a

range of diagnostic and problem-solving strategies throughout the HF simulations. They were actively engaged in the calls, providing situational interventions that ranged from adapting minor skills (such as applying a hard collar on a patient who is lying on a gravel road in an awkward position) to modifying and developing a personal style of practice ("I always get a set of vital signs before leaving the scene"), to dealing with the pressures and challenges of working in the discipline ("These are the calls that are going to bite you").

The preceptors actively worked with the learners to help them discern salient features in the environment and employ a variety of diagnostic strategies. Their situational advice focused on identifying what elements of each call were most important, and why. They challenged students to move beyond asking questions as part of a history-taking procedure and to develop a range of diagnostic strategies, such as identifying key features, developing casual stories, and interpreting semantic qualifiers: the rich relational database of strategies used by expert diagnosticians (Norman, 2007). The preceptors encouraged coherence as a process of observation, interpretation, and meaning-making within an unstructured experience.

The preceptors recognized that the learners are moving into a new community of practice, one that, while sharing common understandings and practices, functions with radically different expectations. The active engagement of the preceptors in the performance of the simulations provided coherence by situating the learners' actions in the new, broader context of field practice, with its dynamic and fluid interactions, situational expectations, and local ways of functioning. Through ongoing discussion and demonstration they helped learners to recognize and engage with the richness of the environment, to begin to discern, interpret, and interact effectively with the world they are entering.

Distributed Control and Neighbouring Interactions

Davis and Sumara (2006) posed the presence of neighbouring interactions and distributed control as the third set of factors that foster emergence of learning in the interactions of complex phenomena. They noted that learning is a translevel phenomenon. "For a social collective to expand its repertoire of possibilities, the individuals that comprise it must themselves learn and adapt" (Davis & Sumara, 2006, p. 142). Fostering individual agency, they claimed, leads to learning and change in both the individual and the overall collective. An effective learning environment, according to Davis and Sumara (2006), requires a sufficient density of ideas to allow "bumping, colliding, and [juxtaposition]" (p. 142) and the spontaneous emergence of shared understanding. Within the context of this study, this implies that effectively fostering clinical judgment involves allowing rich interaction amongst the participants (increasing neighbouring interactions) while decreasing the overt expectations on the type of learning that emerges from individual experiences (decentralizing control).

The HF simulations created an open environment with an expansive set of problems, possibilities, and potentials with which participants could engage. Within the existing curriculum, evaluation focuses on an individual learner who encounters a prespecified set of experiences, each built around predetermined pedagogical expectations. In the HF simulations, all participants in the scenario were allowed to interact in an unconstrained manner that fostered immersive, interactive discussion and exploration. All participants, not just the attendant, were more active and learners were exposed to multiple perspectives and interpretations. Similarly, increasing the scope and diversity of situations, and enhancing the interpersonal, social, and cultural fidelity of the scenarios, expanded the range of contributing and complicating issues.

Emergence of learning is enhanced, claimed Davis and Sumara (2006), by reducing overt

control of the learning environment. Paradoxically, decentralized self-organizing control of multiple entities facilitates the development of complex activity of both the system as a whole and its constituent elements. Thus, rather than creating situations or scenarios that seek consistency of performance (e.g., skill stations focused on specific procedures), complex responses (such as fostering discernment and interpretation) are better supported in dynamic environments which allow for situational and emergent exploration of the unique circumstances of individual cases. Thus, the HF simulations involved all participants in a dynamic, translevel environment in which learning emerged as negotiation of the range of possibilities for action in terms of both collective (e.g., expectations of the communities of practice and within the crew) and individual (e.g., acceptable forms of adaptation and performance in a field setting) activity.

The HF simulations fostered decentralized control through use of calls without predetermined right answers and by encouraging active participation and engagement of all participants. Preceptors were given no advance knowledge of the scenarios and were thus free to interpret and construct an understanding of the situations and their pedagogic implications based on their own experience. The active and interactive participation of all members of the scenarios led to dynamic discussions and the emergence of shared understanding. Interestingly, common themes and trends emerged across the various groups of participants, such as “how we do things in my car,” local negotiation and adaptation of protocols, the need to better discern and interpret the environment, and calls for increased interaction and collaboration, indicators of the tacit background of a community of practice. Yet the “bumping and colliding” of divergent, individual interpretations led to intriguingly varied discussions throughout the HF simulations.

However, further acknowledging and fostering the translevel nature of learning in complex environments is one area for future improvement in the program. While the experiences

in the HF simulations were well received as discreet learning opportunities in which learners received feedback on the clinical judgment they displayed *in that instance*, the overall module and program could better support development of clinical judgment through situating the experiences more deliberately in the context of the learners' overall experience. Clinical judgment emerges in the multiple interactions of participants in a variety of experiences over time, and thus, monitoring and fostering the development of clinical judgment involves engaging the participants throughout their learning. Similarly, while the participants received feedback on individual calls and, to an extent, at the end of the day, neither the learners nor the broader context of the educational program currently has systems or activities for assessing, monitoring, or regulating the development of clinical judgment as a larger process.

Summary

The design of the HFS module provided opportunities for learners to engage in experiences from which they could develop clinical competence and clinical judgment. The simulation environment provided sufficient redundancy and diversity to challenge and support learners, sufficient randomness and coherence to encourage the move from consistency towards holistic perspectives and adaptation, and a blend of distinct learning opportunities nested within an overall experience. The experiences in the HF simulations and in the module itself provided an environment from which the learners could gain an awareness of their own emerging processes of clinical judgment. However, if emerging clinical judgment is a function of multiple encounters of participants in diverse settings and situations, then more attention needs to be given to how the functioning of the HF module fits with the overall experiences of learners (both individually and as a cohort) across the breadth and depth of their overall program.

Assessment and monitoring of clinical judgment requires creating opportunities for the

larger learning environment, the program, its internal (developers, instructors, students) and external participants (e.g., preceptors, other responders, patients and bystanders) that the learners will encounter), and the community in which the participants will practice, to attend to, comment on, and contribute to the ongoing activities of learners across time and performance domains. This in turn requires articulation of conceptions of clinical judgment, identification of its indicators, recognition of the uniqueness of each individual's development of it, and a willingness to let the agents and elements of various performance domains speak with and interact with each other in more asynchronous ways. And these conditions, in their turn, challenge educators and curriculum developers to view curriculum differently.

Fostering the Development of Clinical Competence and Clinical Judgment

The final section of this thesis presents recommendations for curriculum that fosters the development of clinical competence and clinical judgment. The first recommendations explore instructional intent and the creation of practice learning environments: how learning activities are chosen and used, and how fidelity is conceived and incorporated into the creation of practice learning activities. The following discussion suggests rethinking the boundaries of the potential spaces created through the development of curriculum. And the final point situates personal growth and exploration—learning—as a process of becoming.

Pedagogical and Curricular Commensurability

Professional education programs are complex environments involving the interplay of multiple facets of activity and design. Romiszowski (1981) identified two general levels of planning in the design of learning: learning objectives and curriculum. In the following discussion, I refer to activity related to learning objectives as pedagogical considerations and activity at the program level as curricular considerations. Note that while Romiszowski explicitly

adopted an instructional design perspective, conceiving curriculum as a closed system, this study suggests that curricula designed to foster the emergence of clinical judgment are better viewed as complex, open systems. Thus, the two sets of design considerations, pedagogical and curricular, are interactive and co-constitutive rather than dependent.

Conceiving of curriculum as a complex phenomenon recognizes that development and delivery of a program involves dynamic blends of diverse instructional goals, learning outcomes, pedagogical tools, including, in the case of fields such as health education, practice learning activities. The *NOCP* (PAC, 2001), for example, listed over 4,000 competencies and subcompetencies, calling upon approximately 30 action verbs drawn from multiple levels of Bloom's (as cited in Gronlund, 1995) taxonomy of learning, which learners encounter in five different performance domains. These varied competencies are supported by a diverse set of learning activities, such as the activities listed in the Practice Ladder. Yet, as this study has shown, using a single definition of competence for learning outcomes as varied as taking a blood pressure and managing a multiple patient incident is both philosophically inconsistent and educationally impractical.

Pedagogical commensurability refers to the match of a learning activity with its pedagogical, ontological, and epistemological considerations. As seen in Chapter 4, Core Skills drills, Classic Case simulations, and HF simulations involve distinct mixes of goal, structure, instructional activity, and evaluative focus. Instructional design models such as the Practice Ladder are useful constructs for matching desired outcomes with effective instructional strategies and learning activities. Yet, each rung of the ladder, each type of learning activity, rests upon varied sets of epistemogical and ontological assumptions and calls upon different functional requirements and blends of fidelity (see Table 19).

Table 19. Blends of fidelity associated with types of activities in the JIBC Practice Ladder

H	High fidelity
L	Low fidelity
N	Neutral or medium fidelity

Blends of Fidelity:	**Patient**			**Context/ Scenario**			**Curricular**		**Professional**		**Culture of Practice**	
Learning Activity	Physiological	Procedural	Interpersonal	Environmental	Participant	Role	Case	Richness/ Information	Context of Practice	Community of Practice	Diversity	Cultural Setting
Practicum	H	H	H	H	H	H	N/A	H	H	H	H	H
Clinical	H	H	H	L	L	L	N/A	H	L	L	N/A	L
Immersive Simulation	N	N	H	H	H	H	N	N	H	H	H	H
Procedural Simulation	H	H	N	N	L	N	H	N	N	N	L	L
Drills/OSCE	L	H	L	L	L	L	H	L	N	N	L	L
Skill Station	L	H	L	L	L	L	H	L	L	L	L	L

Effective learning activities match these factors, ensuring that learning outcome, activity, and evaluation are congruent. Thus, different learning activities such as skill stations and practicum calls may build upon common procedures and foundational knowledge, but the structure, use, and evaluation of learners in these activities are nested within very different conceptions (see Figure 29).

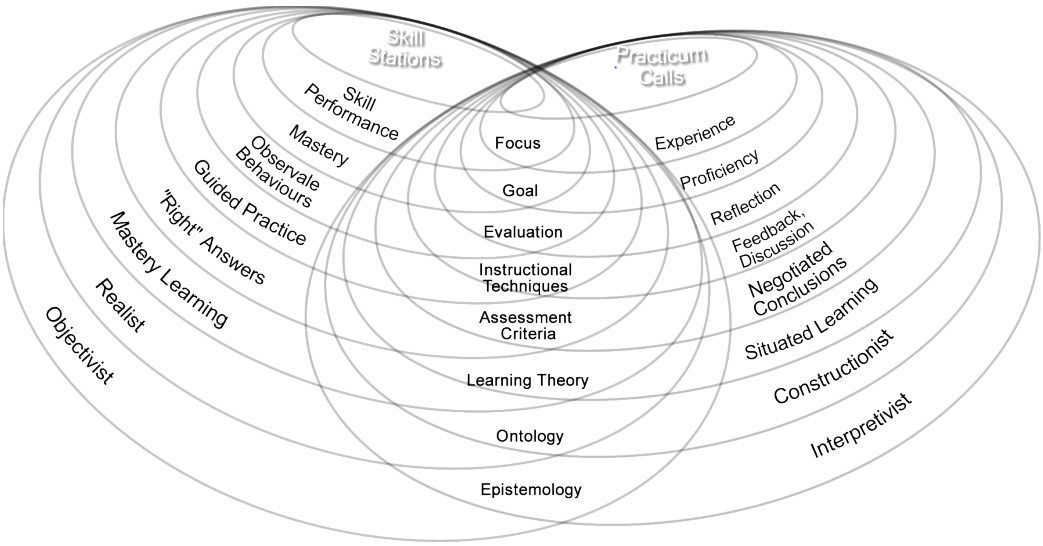

Figure 29. Comparing pedagogical commensurability of Skill stations and Practicum calls.

Curricular commensurability refers to the fit of a curriculum's overall structure with its underlying conceptual assumptions. This macro structure, often established through metaphor (Romiszowski, 1981), sets the boundaries and limits the outcomes that a program may include. The existing PCP program uses a building block metaphor, structuring both the course content and the courses themselves in a simple-to-complex sequence. The metaphor implies a closed structure with predefined outcomes. Curriculum developers can use a variety of conceptual models to structure the learning activities of the program. For example, in contrast to bottom-up models such as PCP, top-down approaches, such as problem-based learning, present learners with a case to analyze, then ask the learners to self-identify learning gaps and needs for subsequent study. Doll (1993), calling upon postmodern conceptions of learning, suggested a nodal infrastructure, with course content and activities organized around highly connected sets of ideas. These metaphors create more open structures and allow for multiple, emergent outcomes while still providing overall focus and structure to a program.

There are two important caveats in this discussion: 1) pedagogical and curricular

commensurability function at different levels of organization, and 2) the implied progression in the structure of instructional models such as the Practice Ladder are not necessarily associated with similar hierarchies in the factors affecting pedagogic commensurability.

Pedagogic commensurability focuses on learning strategies and activities while curricular commensurability refers to the curriculum as a whole. An effective program consists of individual learning outcomes and objectives based on its curricular framework, and those objectives call for the use of specific types of learning activities. Thus, pedagogic and curricular facets are linked. But this does not imply that pedagogical and curricular commensurability are the same thing, or that decisions made at one level of conception/organization can be unproblematically imposed on another.

The simple-to-complex sequencing of learning activities in the existing PCP program is generally effective and efficient. There is, however, a mismatch between the learning activities and the evaluative activities of the program. The *NOCP* (PAC, 2001) has employed a behaviourist definition of competence across all of its learning domains, which focuses on technical competence as evidenced through predefined observable behaviours. The program has embedded this concept in the evaluation tools of Core Skills, Classic Case simulations, and the clinical practicum log books. Imposing a single definition of competence across multiple forms of learning activities that involve diverse, and sometimes divergent, learning outcomes is neither effective nor consistent with the structure of the learning activities themselves. Indeed, it is a direct factor in creating the tension between classroom and field expectations examined in this study.

Jonnasen (2003) noted that efforts to impose a unified theory of learning are unlikely to succeed. As noted above, most professional programs are a blend of desired learning outcomes,

each calling for different approaches and evaluative structures. Curriculum is a potential space of interaction between multiple complex phenomena and efforts to impose a single instructional voice or evaluative lens are impractical. Foucault (1980) warned against the creation of hegemonic theories, and the tension between instructors and preceptors in this study supports his concerns.

Thus, curriculum intended to foster emergence of complex outcomes requires careful attention to both pedagogical and curricular commensurability. Effective programs thrive when conceptually consistent, when an organizing paradigm of some sort provides shape, structures (loosely or tightly) activity, and supports engagement and emergence of learning. However, the individual learning activities within such a curriculum are most effective when they are, themselves, pedagogically commensurable. Different ways of knowing require different types of activity, different methods of assessment.

Within the context of this study, I have emphasized that the evaluative methods used in a program must match the desired outcomes and choice of learning activity. Even more specifically, I have recommended that professional documents and concepts such as the *NOCP* (PAC, 2001) modify their evaluative focus and approach in different performance domains. Academic (or didactic), simulation, clinical, and practicum placements involve different kinds of learning with the goal of fostering different ways of knowing. Even within a particular performance domain, different types of learning activities call for different approaches as learners move from the desired consistency of context-independent skill performance to the socially constructed integration and adaptation of procedures and protocols in dynamic simulation environments and, finally, to the socially negotiated and shared understandings arising from co-emergent activity between partners in a field setting.

A simulation-based learning environment that seeks to replicate the practicum environment must be more than an extension of environments based on procedural learning outcomes. Fostering clinical competence and clinical judgment require spaces that match the evaluative expectations, instructional approaches, open-ended, and socially negotiated practices of the field environment. Thus, simulations that foster the development of clinical competence and clinical judgment require attention to more than physiological and procedural fidelity.

Fidelity

This study validated the conception of fidelity as a complex construct involving deliberate selection of factors and relationships that are relevant to the desired learning goal. Importantly, increasing the overall fidelity of a simulation, or even bringing to the forefront specific aspects of fidelity, does not necessarily lead to increased engagement or improved learning outcomes. The most effective simulation environments blend selected aspects of fidelity, while streamlining and verbalizing other aspects to support the types of interaction and engagement required to meet specific types of learning outcomes.

Throughout the study, learning activities involved different blends of fidelity that allowed for effective learning. *All* practice learning activities relied on high fidelity of some aspects of the simulation (usually procedural fidelity), while other aspects were verbalized or imagined in almost all calls. Thus, it does not make sense to talk about *the* fidelity of any particular learning activity. Rather, the overall fidelity of a practice learning activity is a function of the fit of its elements with the requirements of the activity.

Table 19 presents an initial conception of how the aspects of fidelity considered in this study best relate to particular learning activities within the context of paramedic simulations. Note that the relationships in this table are not linear or consistent across or between activities.

Each activity calls upon a different blend of features. The intent of this table is to provide a starting point for instructors or developers who are constructing paramedic simulations. The specific blends of fidelity to be highlighted in a particular learning activity depend on the specific learning goal, the resources available, and the functional requirements of the activity. The goal is not to match reality; it is to create an effective space for exploration of concepts, performance, and judgment.

Literature on simulation often makes the assumption that higher level learning outcomes require higher overall fidelity and that all practice learning activities should be as rich and have as high a fidelity as possible (Beaubien & Baker, 2004). The results of this study indicate that effective learning is not necessarily dependent upon recreating a realistic environment. Rather, it is important to create an environment in which learners can engage with an environment *realistic enough to meet their learning goals*. Many of the moments of aporia (times when learners were unable to process the moment and popped out of the call) occurred when participants encountered environments that had too much going on or when encountering facets of the environment that they could not interpret. While high procedural fidelity was present in most simulations examined in this study, effective learning occurred within a wide range of environments, with considerable variation in environmental, role, social, and cultural fidelity.

This has several practical implications. While existing literature and practice in medical simulation has tended to focus on physiological and environmental fidelity (see, for example, Kneebone et al., 2006), the conception of clinical judgment as awareness and attention to the broader setting suggests that more attention should be paid to other forms of fidelity. Perhaps the most prominent factors fostering the development of clinical judgment in this study were increasing the role fidelity of the simulations in the HFS module and setting the simulations in

the practicum environment. Many of the Classic Case simulations were staged in realistic environments, employed actors or mannequins as patients, and included other responders. Yet, the dynamics between participants were constrained by focusing on the attendant and restricting the role of the driver and interventions of the instructor. Increasing the role fidelity and introducing the preceptor allowed for more immediate and interactive participation of all participants. Similarly, populating the simulations with other responders and bystanders increased opportunities for participants to engage with each other, gather information, and interact more authentically.

Additionally, the findings in this study suggest that effective simulations make use of actors and standardized patients as well as HF mannequins. While the mannequins provided high physiological and procedural fidelity, they did not allow for interpersonal and social interaction. Participants in this study were occasionally distracted when using mannequins as patients during transfers or when participants were unfamiliar with which side of a mannequin could be used for taking pulses and blood pressures. In particular, actors with adjuncts such as IV arms were more effective for scenarios involving conscious patients and situations involving social interaction.

This has practical application to the central dilemma addressed in this study. Current paramedic simulations are structured environments designed to foster technical competence. The results of this study indicate that simulation environments can partially recreate the conditions of field practice. However, the blend of fidelity that fosters the development of clinical judgment is less dependent on the physiological and procedural fidelity of mannequins and actors than on the role, social, and environmental fidelity of the scenario. Simply raising the overall fidelity of the simulation environment is unlikely to foster clinical competence and clinical judgment, particularly if paramedic programs recreate forms of simulation laboratories common in many

health education programs. These laboratories focus on the use of task trainers and HF mannequins and recreate settings such as medical wards, emergency departments, and operating theatres. Paramedics' use of such facilities, and an emphasis on HF mannequins and trainers, are best suited to procedural learning and, as such, focus on technical competence. While the physiological and procedural fidelity of these laboratories is high, simulations staged in these settings lack environmental fidelity (for paramedics and other prehospital practitioners) and have poor interpersonal fidelity (even when an instructor speaks for the mannequin).

Thus, I recommend that curriculum developers assess the learning requirements of each individual scenario and choose the blend of fidelity—and the most appropriate choice of setting, participants, and technologies—best suited to achieving their desired learning outcome. Simulations intended to foster clinical competence and clinical judgment must provide occasions for discernment; they must create a milieu involving complex interpersonal interactions and more genuine opportunities to engage in clinical decision making. Thus, paramedic simulations must be as concerned with role, environmental, interpersonal, and social/cultural fidelity as with physiological and procedural fidelity. In this sense, populating simulations more richly with actors, bystanders, and authentic interdisciplinary responders may often be more important than the use of HF mannequins.

The Curricular Switch

The existing curriculum separates simulation (with its focus on technical competence) and practicum experiences (with their focus on adaptation, discernment, and clinical judgment). As noted in this study, these two domains are linked, yet possess distinct goals and methods of evaluation. Students must demonstrate technical competence in formal evaluations before moving into the field setting (with its clinical assessment), and the students experienced the

transition between these differing sets of expectations as a gap or tension.

By most measures, the existing program is effective, efficient, and meets its goals. Its pass rates, success of graduates in licensing examinations, and employability are exceptional (School of Health Sciences, 2010). Yet, all stakeholders realize that a gap still exists in which the learners and graduates of the program are not ready for the open-endedness, socially negotiated milieu, and dynamic environment of field practice.

A curriculum which seeks to move past the goal of competent practice requires a curricular switch—moments or movements of focus from consistency to diversity. Part of this curricular switch is a move from the construction and development of competence towards fostering the emergence of complex responses such as discernment and clinical judgment. As noted above, fostering of proficiency and expertise involves exploring how situations are different from each other rather than focusing on developing consistency of approach.

There are a variety of ways to incorporate this switch. The existing program simply chooses to create two overlapping settings and not directly address the transition between them. Since participating in this study, however, the JIBC's PCP program faculty have added a layer of immersive activities onto the existing curriculum framework. The JIBC's PCP program has formally introduced a day of preceptor-based immersive simulations on the last day of the classroom component of the program. The results in post-course evaluations from students and preceptors have been very positive (S. Mills, personal conversation, November 2, 2012). The program now also incorporates procedural, integrative, and immersive simulations within the curriculum and is looking at ways to introduce higher role fidelity earlier in the program.

Other options may include breaking the curriculum into blocks, each of which would include a period of immersive simulations and practicum placements. In this model, learners

encounter the field environment (both in simulation and practicum) several times throughout the curriculum (this is the model currently used by the 18-month ACP program). More radical options could involve re-envisioning and restructuring delivery of the curriculum around nontraditional concepts. Doll (1993), for example, suggested a postmodern conception of curriculum as organized around highly connected ideas, rather than traditional subject areas. Such a conception might organize paramedic experiences through the lens of diagnostic categories, leading to problem-based exploration of underlying clinical sciences, assessment, and management, a top-down approach that could lead to very different ways of both structuring and experiencing paramedic programs.

Significance of the Study

This study has both theoretical and practical significance to those seeking to understand, develop, and use simulation to foster learning and the development of clinical judgment in professional practice. The study has implications for the design and delivery of simulation-based learning environments, the use of experiential learning activities, and conceptions and design of curriculum.

The study develops and extends conceptions of clinical competence and clinical judgment for paramedics beyond procedural models and the use of clinical reasoning strategies. These conceptions open a space for exploring how practitioners engage with their environment and how they attend to and integrate broader facets of that environment into their decision making. These conceptions will allow future studies that explore how clinical judgment in paramedics develops, how it can be assessed, and what factors contribute to its emergence and maintenance. The results of these studies will have direct application in the design and delivery of both initial education and ongoing professional development.

The study adds to the growing literature that explores the characteristics and pedagogical uses of practice-based learning activities: simulations and their derivatives. This study provides rich descriptions of how learners and participants interact within a simulation-based learning environment and how simulation can be used to foster the development of skills, knowledge, attitudes, judgment, and expertise. These conceptions spur a set of practical recommendations for the construction and use of simulation environments in developing critical thinking, clinical judgment, and expertise. The findings of this study emphasize that fostering the development of clinical competence and clinical judgment requires more than increased overall fidelity. I provide a framework for matching desired learning outcomes with potential practice learning activities based on learning focus, assessment method, underlying learning theory, and epistemological and ontological presuppositions. I suggest an approach for considering blends of fidelity appropriate to the use of specific practice learning activities.

Finally, this study contributes to academic literature on curriculum theory through an exploration of how simulation may be used within paramedic curriculum to bridge the gap between the comfort of technical competence and the complexity of field practice. This study incorporated both instruction-centric metaphors of construction with learner-centric metaphors of personal journey and growth. The resulting conception of curriculum as a potential space of guided exploration more richly represents the nested, overlapping, and mutually contingent processes of instruction and learning within the context of developing professional practice.

Conclusion

The recommendations above broaden the conception of learning in professional settings to explicitly acknowledge and foster the process of entering a community of practice and becoming a practitioner.

Instructors and practitioners *do* know in different ways. The learners within the curriculum structure are in a process of becoming active practitioners. The existing curriculum, and the practice learning activities that populate it, focus on shaping the learners towards the institutional description of entry-to-practice paramedics as outlined in competency documents, licensing criteria, and curriculum goals and objectives. Learners must work towards these patterns of practice in order to pass the program's examinations and the licensing evaluations.

But field practice requires a different perspective and field practitioners judge performance in more social and dynamic ways. As learners move into the field practicum, they must make choices within a bewildering set of nested, overlapping relationships and expectations. Having successfully become paramedic students, they must now start to become paramedic practitioners.

Both the students and the program personnel are caught between these two sets of expectations. Too strong a focus on technical competence isolates learners and instructors from the mainstream of their field of practice and leads to criticism that graduates are book smart but unready for practice. Yet, if instructors foster the movement towards clinical competence too overtly, they risk alienating the students from the institutional expectations and licensing evaluations which are a prerequisite for entry to the profession. Subjectivist perspectives that focus on clinical judgment over technical competence, or guidelines and exploration over protocol and procedure, may lack rigour and accountability.

The challenge, then, is to look to create experiences that allow practitioners to function in these two fundamentally different domains. The first step in meeting that challenge is to acknowledge its existence. Technical competence and clinical competence are not exclusive. In the same way that the domains of the classroom and the field share an overlapping set of

processes and concepts, technical and clinical competence are nested, co-constituting conceptions. It is difficult to be clinically competent without underlying skills and knowledge. It is difficult to develop and maintain technical competence without considering the context of its practice. There is a time for rigour and the development of consistency and a time for its application in increasingly dynamic settings. There will always be tension between the two settings, but that tension provides the opportunity for learners to distinguish between them, to explore their shared structures and differing needs, to overtly name and frame the exploration of their chosen field. This tension reminds learners that they neither learn nor practice in isolation. All activity is grounded and situated in social contexts, and part of entry to both communities of practice (that of the school and that of the field) is recognition of which domain one is working in. Learning will always be "learning in" a context. Performance will always be "practicing within" a community. Clinical judgment involves, in part, recognizing and discerning between the characteristics of these contexts and communities.

Such an approach opens up the curriculum from its focus on forms and structures to consideration of learning as ongoing exploration of a domain of practice. Part of the learners' experience of the gap is not recognizing that they are transitioning from one community of practice to another. From the learners' perspective, each community of practice is nested within the ongoing experience of their careers; both are potential spaces of exploration. Thus, a curriculum that fosters the emergence of clinical judgment and expertise must look beyond its boundaries. The curriculum is a complex phenomenon that interacts and exchanges information with the overlapping domain of field practice and the experiences of those who participate in it. This boundary has always been porous; instructors foreshadow field practice even as they caution against picking up "bad habits," and preceptors explicitly call back to both their own and

their learners' experience in the classroom to support coaching in the field. However, recognizing, acknowledging, and encouraging further exchange between classroom and field practice reduces the impact of learners' transition between them.

Teaching, learning, and professional practice are each complex processes that involve dynamic interactions and blended experiences. The overlap and interplay among these phenomena leads to the creation of intriguing potential spaces of guided exploration in which learners may attain competency, foster proficiency, and develop clinical judgment and expertise.

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APPENDIX A: INFORMATION LETTERS, CONSENT FORMS, AND MEDIA RELEASES

Information Letter for Students

Thank you for your interest in participating in this research.

My name is Ron Bowles. I am a PhD candidate in Curriculum and Pedagogy in the Faculty of Education at the University of British Columbia. I am conducting this study under the direction of my supervisor, Dr. Don Krug, from the Faculty of Education at UBC. This research is being conducted as part of my doctoral studies. I will produce a thesis and series of articles and conference presentations based on this study.

Support and Potential Conflict of Interest. The Justice Institute of British Columbia is supporting this research with assistance in equipment, personnel, and access to facilities. My doctoral program is supported by a Canada Graduate Scholarship through the Social Sciences and Humanities Research Council. I also lead the Paramedic Academy's curriculum development, credentialing, and applied research group. I am a former EMA II paramedic, paramedic instructor, and curriculum developer. Please note that while this research is conducted with the support of the Primary Care Paramedic program, the study is not part of your program and your participation, non-participation, and performance in the study will have no effect on your standing in the program.

There are two following documents for you to complete.

The Consent Form gives you specific information about the purpose and procedures of the study, the potential risks and benefits of participation, and steps taken to protect the confidentiality of your participation. By signing the Consent Form you agree to participate in the study.

The second form is a media release. If you choose to sign the media release form, you allow me to use images and video clips in which you may be identifiable in presentations and publications describing the study. You can choose to participate in the study (by signing the Consent Form), but choose to not allow media in which you may be identifiable.

Further information and contacts

If you have questions, comments, or concerns, please contact me at:

Ron Bowles
[telephone number]
[email address]

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Consent and Media Release Forms for Students

Clinical Judgment in High Fidelity Simulations

Thank you for your interest in participating in this research.

My name is Ron Bowles. I am a PhD candidate in Curriculum and Pedagogy in the Faculty of Education at the University of British Columbia. I am conducting this study under the direction of my supervisor, Dr. Don Krug, from the Faculty of Education at UBC. This research is being conducted as part of my doctoral studies. I will produce a thesis and series of articles and conference presentations based on this study.

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Purpose of the Study. The purpose of this research is to explore the development of clinical competence and clinical judgment in a high fidelity simulation environment. I am asking you to participate in a one day high fidelity simulation module. The simulations in this module are designed to more closely resemble the variety and nature of the practicum and field environment. I am interested in two sets of questions that explore how you interact with the various elements of a high fidelity simulation and how you perceive your own performance. The primary research questions are:

- How does a high fidelity simulation learning environment influence (positively or negatively) the development of clinical judgment in recruit paramedics?
- How does a high fidelity simulation learning environment influence (positively or negatively) metacognition of clinical judgment in recruit paramedics?

Study Procedures

If you choose to participate in the study, you will be asked to:

- Complete and sign an informed consent letter agreeing to participate in the study.
- Complete and sign a media release form allowing me to use video clips and photographs from the simulations you perform in articles, conference presentations, and multimedia

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lessons. Please note that you can agree to participate in the study, but choose to not allow media in which you can be identified to be used.

- Complete a questionnaire describing your background and experience.
- Allow video recording of selected simulations (including the set up and debrief) in the Classic Case 253 course. You may be asked to wear a head mounted camera. Copies of your written documentation will also be collected as data for the study.
- Complete a reflective journal regarding your CC 253 simulations.
- Participate as a paramedic in a high fidelity simulation module. You will participate both as an attendant and a partner/driver in a series of high fidelity simulations.
- Allow video recording of the simulations, including the set up and debrief of the calls. You may be asked to wear a head mounted camera. Copies of your written documentation and notes will be collected as data for the study.
- Complete a reflective journal regarding your experience in the high fidelity simulation module.
- Complete a reflective journal regarding your Clinical Practicum experience.

In addition, you may be asked to participate either as an individual or as part of a small group in a 90 minute interview that will explore your experience in the module and/or your subsequent practicum.

Potential Risks and Benefits

While the new module does not include formal evaluation, you will be participating in simulations and will be assessed and receive feedback. In addition, the simulation setting is different from other simulations that you have completed during the program. Thus, you may be at risk for social harms such as threats to reputation and/or psychological harm such as anxiety or regret. In addition, paramedic practice involves situations which are physically stressful and emotionally charged. The intent of the new simulation module is to more richly portray the complexity and noise of field practice and this will be, for some participants, their first exposure to the unpredictability of field practice. The JIBC has policy and resources available to students who experience anxiety and/or critical incident stress during any component of their training. You will have full access to these resources if required.

There are several potential benefits to taking part in this study. You will be able to participate, both as an attendant and a driver in additional simulations. The simulations in this study are designed as “bridges” between the classroom and the field. Rather than having an evaluator who is marking your performance, a field preceptor will participate in the simulation with you. The preceptor will provide guidance and advice in a manner similar to his or her role in your field

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practicum. The intent is to better prepare you for the practicum and field environments. The results of this research will help us to improve future programs.

Your participation in this study is completely voluntary. Your participation or non-participation will not affect your standing or evaluation in the PCP program. If you choose to enter the study, you may choose to not participate in any particular component or activity in the study. You may also withdraw from the study at any time, for any reason. If you withdraw from the study, you may also remove any data, media, or contributions you have made from the study. However, due to the nature of the study, it may be difficult or impossible to isolate particular findings that have emerged from analysis up to the point of your withdrawal.

Confidentiality

I will take several measures to keep your participation in the study anonymous and confidential. All paper-based data will be maintained in a locked filing cabinet within a locked office. All electronic data (including video files, audio files, transcripts of these files, and my working notes) will be maintained on a password protected folder and on a password protected external hard drive that is kept in a locked office. All data, documents, and participants will be identified by code numbers or code names. Code names will be used in all transcripts. You will not be identified by name in any reports, publications, or presentations based on this study. You may be asked to participate in an interview with a small group. We encourage all participants to refrain from disclosing the contents of the discussion outside of focus group and simulation sessions; however, we cannot control what other participants do with the information discussed.

I will be collecting several types of data from this study. I will make notes based on my own observations. I will collect video recordings of simulations (including the set up discussions and debriefing sessions) and interviews. I will collect copies of your patient care records and other forms of notes related to the simulations. I will collect your written information from the demographic survey and the reflective questionnaires. I will also conduct and record interviews with selected participants in the study. I will provide transcripts of audio and video recordings for you to review for accuracy. You may also provide additional comments if you choose.

Further information and contacts

If you have questions, comments, or concerns, please contact me at:

Ron Bowles
[telephone number]
[email address]

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Clinical Judgment in High Fidelity Simulations

If you as a participant have concerns or questions that you feel you cannot discuss with me, please contact either of the following people:

Dr. Don Krug
Professor, Department of Curriculum and Pedagogy
Faculty of Education
University of British Columbia
[email address]
[telephone number]

If you have any concerns about your treatment or rights as a research subject, you may contact the Research Subject Information Line in the UBC Office of Research Services at 604.822.8598 or if long distance e-mail to RSIL@ors.ubc.ca .

Thank you again for your interest in this study.

If you would like to participate in the study, please do the following:

- Complete and sign the Informed Consent letter.
- If you agree to the use of media in which you may be identified in articles, conference presentations, and learning materials, please complete and sign the Media Release form.
- Complete the questionnaire on your background.

You can return the form(s) in a sealed envelope by post, to your program instructor, or in person to my office on the 3rd floor of the New Westminster campus of the Justice Institute of BC. Please address the envelope to:

Ron Bowles
[telephone number]
[email address]

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Informed Consent Form

Your signature below indicates that you have received a copy of this consent form for your own records.

Your signature below indicates that you consent to participate in the research study entitled "Clinical judgment in high fidelity simulation."

You understand that you will participate in a series of video-recorded simulations and may be asked to participate in subsequent surveys or interviews which will also be video recorded. You understand that you will be asked to submit student assessment forms, reflective journals, and other notes and documentation as part of this study. You understand that you will be able to review the edited clips and transcripts of all media in which you participate.

You understand that you may withdraw your participation, including all contributions to the study, at any time with no repercussions.

You understand that you will receive online access to, or a hard copy of the resulting research report(s).

Date _____

Signed _____

Name (Please Print) _____

Email (optional) _____

Phone _____

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Media Release

Your signature below indicates that you have received a copy of this consent form for your own records.

Your signature below indicates that you agree to allow the use audio, video, and or photographs collected during the research study entitled "Clinical judgment in high fidelity simulation" in which you may be identifiable in articles, conference presentations, and/or web publications.

You understand that you will receive online access to, or a hard copy of the resulting materials.

Date _____

Signed _____

Name (Please Print) _____

Email (optional) _____

Phone _____

APPENDIX B: DATA TABLES

Table B1. Characteristics of three simulation environments

	CS 220 Drill	CC 253 Procedural Simulation	HFS Immersive Simulation
Pedagogical Intent			
Location in curriculum	Second of eleven courses Early in program	Eighth of eleven courses Before learners move to clinical practicum	Between tenth and eleventh course End of classroom components and final exam, but before learners move to clinical practicum
Sample learning objective/Outcome	Principles of management: Hemorrhage Control: assess and manage patient with epistaxis	Assess and manage classic presentations of cardiac chest pain using PCP procedures and protocols	Function as paramedics in a simulated field setting
Focus	Mastery of skills in procedure; sequencing of procedure in Primary and Secondary Survey	Recognition of cardiac chest pain Decision to use appropriate protocol Integration of assessment and treatment in overall management of call	Overall assessment and management of call Function in a team-based environment Recognize and incorporate interpersonal, environmental, social, and cultural aspects of situations
Structure			
Length of simulation	10 minutes	30 minutes	Varied: 10 minutes to 50 minutes
Physical location	Large classroom—multiple groups	Plenary classroom for set up and post-call discussion Individual classrooms as staging areas, mock ambulance Individual classrooms and appropriate locations across campus for scenarios	Plenary room for set up to day and end-of-day debrief Mock hospital Mock ambulances (classroom or gymnasium) Scenarios staged across campus
Patient	Student in role play. No moulage or props	Student in role play. No moulage or props	Actors in role play with moulage and props; high fidelity mannequins for specific calls

Table B1. Characteristics of three simulation environments

	CS 220 Drill	CC 253 Procedural Simulation	HFS Immersive Simulation
Other participants	Students as crew and first responder; other roles verbalized	Students as crew and first responder; other roles verbalized	Students as attendant and driver Field paramedic as preceptor Police and fire recruits
Script format	Drill with principles of management narrative	Multiple page script with scene set up, patient presentation, detailed signs and symptoms, alternate findings based on treatment options	Single page Goal statements for underlying condition/injury Role play statements for bystanders and other responders
Team/Group composition	Student as attendant; student as driver; student as patient; student as first responder	Student as attendant; student as driver; student as patient; student as first responder	Student as attendant; student as driver Field paramedic as preceptor
Preparation	"military drill" style; instructor gives verbal directions to patients, then gives	All patients are brought together and briefed by instructor. Patients given scripts and details on how to present information in call. Patients then move to scenario locations and set up physical scene as necessary. Instructor meets with all crews and gives a single description of the call to all groups.	Call manager sets up physical location and mannequin (if necessary) Goes over role play instructions with participants; gives examples or clarification of expectations ("you are trying to console him")
Pedagogical Structure			
Role of instructor	Instructor in classroom as "expert" Direct drill, monitor all groups and provide feedback	Instructor circulates between groups, functions as "expert" and "facilitator" Set up scenario, circulate between groups, facilitate as required Note issues or concerns for group debriefing Provide assistance or answer questions	Preceptor acts as coach and mentor Preceptor participates in call as required Guides and coaches learners as required, intervenes when necessary for crew and/or patient safety Provide direction during call Provide feedback in post-call debrief

Table B1. Characteristics of three simulation environments

	CS 220 Drill	CC 253 Procedural Simulation	HFS Immersive Simulation
		for individual groups of students Provide individual feedback as required	
Assessment/Evaluation framework	Acceptable/unacceptable Mastery checklists Principles of Management algorithms	Acceptable/Unacceptable Treatment and protocol algorithms Generic patient assessment checklists Mastery checklists for specific procedures	Feedback and discussion Asked to comment on differences between field and classroom practice
Feedback	Individual feedback during drill Class feedback at end of drill	Peer-driven feedback during and immediately after scenario Group feedback in plenary session after all groups have completed scenario	Peer and preceptor feedback during call Preceptor provides commentary, discussion, and specific feedback after call in debriefing session
Documentation	Mastery checklists	One page generic checklists	None Preceptor form (based on competency profile)
Fidelity			
Physiological	Low Verbal description of key features of condition Minimal context to set mechanism of injury Verbal description of signs and symptoms	Low; exception for unconscious or collapse patients using mannequins (not observed in study) Verbal description of key features of condition Moderate to high context to set mechanism of injury/history of chief complaint Verbal description of signs and symptoms	High to medium Use of mannequins for unconscious or collapse patients (high physiological fidelity) Use of actors as patients for conscious patients. High physiological fidelity in calls with normal vital signs. Call manager provides alternate findings when actor's vital signs do not match scenario (medium fidelity)
Procedural	Medium to high	Medium to high	Medium to high

Table B1. Characteristics of three simulation environments

	CS 220 Drill	CC 253 Procedural Simulation	HFS Immersive Simulation
	Use of authentic procedures and equipment Verbalize invasive procedures	Use of authentic procedures and equipment Use of task trainers for specific invasive procedures, such as IV, SC drug administration; other procedures (e.g., insertion of oropharyngeal airway) verbalized. High procedural fidelity when using mannequins (not observed in study)	High for mannequin-based calls (exception: lifting and transferring) High for actor-based calls that do not require invasive procedures or administration of medication. In these cases, procedures are mimed or verbalized (medium fidelity)
Environmental	Low Verbal description of scene Minimal information: enough to set scene and mechanism of injury	Low to medium Verbal description of scene Significant information on scene and environment presented Some simulations staged in more authentic locations using campus facilities (e.g., gymnasium, cafeteria, offices, outdoor locations)	High Authentic locations used (e.g., parking lot, recreation centre, pool, simulation apartment, etc) Scenarios populated with family members, bystanders, first responders, police, hospital staff
Role	Limited Attendant as prime participant Driver in support role only; task level actions (“take blood pressure”); acts under direction of attendant	Limited, but increased Attendant is prime participant Driver in support role, but can initiate common procedures (e.g., oxygen, pulse oximeter, prepare stretcher, etc) Driver functions at procedure level (e.g., “take vital signs) under direction of attendant	Medium to high Attendant and driver encouraged to function as team in more authentic relationship with each other (e.g., discuss call and options, give advice, initiate actions) Preceptor-based call to mimic field practicum. Preceptor allowed to function as s/he would in a “real” practicum Note that in practicum situation, crew usually consists of student, then field paramedics as partner and preceptor. Thus, while the participants were encouraged to interact in

Table B1. Characteristics of three simulation environments

	CS 220 Drill	CC 253 Procedural Simulation	HFS Immersive Simulation
			authentic ways, the driver was an inexperienced student rather than an experienced paramedic.
Curricular	High Situation is designed to clearly indicate need for procedures being practiced; few distractors or variables to consider	High Situation designed to provide prototypical examples of common injuries and conditions Practice assessment and steps in clinical reasoning Practice variations in treatment algorithms (e.g., patient improves or deteriorates based on treatment)	High Situations were designed to provide a range of acuity and outcomes to medical conditions; provide opportunities for interpersonal and intraprofessional interaction; situate participants in rich environmental, social, and cultural contexts
Community of Practice	Curriculum Procedures and criteria for performance drawn from program's treatment manual	Curriculum Procedures and criteria for performance drawn from program's treatment manual	Field practice British Columbia Ambulance Service protocols and procedures; local field procedures and expectations New Westminster learners worked with Vancouver area practitioners; Kelowna learners worked with practitioners from the Okanagan

Table B2. Statements of finding sorted by research question and subquestion

Question	Finding ID	Findings
SQ1: Who and what do participants interact with and how do they interact with them?		
Bounding Question 1: What is a unit of interaction?		
	s1b101	Twenty seconds
	s1b102	Often around step or action
	s1b103	While often doing several things, only interacting with one concept at a time
Who/what do they interact with?		
	s1b201	Surprisingly little interaction with richer physical environment
	s1b202	Focus on patient, missed other potential patients in calls
	s1b203	Pt interaction categories: pt as condition, some concept of condition
	s1b204	Few instances of the participants in the HF scenarios interacting with their patient as a person with a health and life history
	s1b205	Tunnel vision: (NAR, information sources); misinterpretation of scenes
	s1b206	Lack of interaction with social environment (FR, bystanders, family)
	s1b207	Lack of interaction with other responders
	s1b208	Partners: more collaborative/consultative than 220, 253
	s1b209	Call managers: provide verbal information/Attendant/Partner seeking validation
	s1b210	Popping out: information/validation seeking
	s1b211	Equipment used confidently, smoothly
Bounding Question 3: What are they doing?		
Attendant/Partner codes		
	s1b301	220: Attendant autonomous, others passive, even not helpful, disengaged
	s1b302	Exception: “the dance” around collaborative activities such as loading for transport
	s1b303	253: Partner more autonomous; longer procedural chains
	s1b304	HFS: partners quite autonomous, participating in decision making, often taking on aspects of patient care or assessment in parallel or independently

Table B2. Statements of finding sorted by research question and subquestion

Question	Finding ID	Findings
Preceptor codes		
	s1b305	Running in parallel—“Creating call” in front of students; build understanding of call so they can give feedback
	s1b306	Range of roles and strategies: independent, prompt, coach, direct, intervene
	s1b307	Making call easy by laying out equipment: demonstrating role of partner
	s1b308	Surprised at “popping out” to talk about call as though patient was not there
	s1b309	Less direct intervention on critical calls than expected (e.g., mci)
	s1b310	Feedback all over the place—very situational
	s1b311	Not a lot of discussion on clinical reasoning (surprising)
	s1b312	Tended to call upon informal sources of authority (see later on Call to Truth)
Call Manager codes		
	s1b313	Generally low key
	s1b314	Sometimes slipped back into instructor mode: coaching/directing
	s1b315	Language tended to be more diagnostic rather than natural words of pt
How immersed do they seem to be in the call?		
	s1b401	“Popping out” for information, validation, aporias
	s1b402	Less engaged during transit and discussion segments
	s1b403	Occasionally engaged in discussion with preceptor as though patient was not there
	s1b404	For PCP, sometimes talking “over the call”
	s1b405	ACP moved seamlessly between cognitive concept of call and physical
	s1b406	Even in more robust and richer environment, participants seemed reliant on and look for verbal cues over physical environment
	s1b407	Surprisingly, procedural fidelity quite high across simulation domains (220, 253, HFS)
	s1b408	Low procedural fidelity usually associated with times when information not available or A/P could not interpret or understand (moulage, mannequin voices)
	s1b409	Interesting use of mimicking and mirroring even when verbally asking for information—definitely kinesthetic environment

Table B2. Statements of finding sorted by research question and subquestion

Question	Finding ID	Findings
	s1b410	Reliance on/seeking verbal information sources, even when physical present (challenges fidelity as unifying/unitary concept)
	s1b411	NOTE: time compression a benefit of sims
Where are they getting information from?		
	s1b501	Researcher disappointment: not engaging w/env, seeking verbal info, continuing to translate findings into diagnostic terms (ask patient: do you mean?)
	s1b502	In HFS, still relying more on, or seeking verbal interpretations of environment than expected: more env than 220, 253, but still pronounced
	s1b503	Often go verbal when "flaw in the matrix" (moulage/mannequin/non-standard vital findings)
	s1b504	Call managers sometimes began offering information: ? Prompt call?
	s1b505	Preceptors encourage the students to take richer histories from their patients throughout the HF days
Subquestion 2: how is their domain knowledge evident?		
	s2	
Bounding Question 1: are learners' domain skills evident in the performance of the simulations?		
	s2b101	Not a single instance of a preceptor saying to a crew that "you were wrong," or that "you would have failed."
	s2b102	Ten simulations in which students made errors which would have been marked as incorrect in a classroom setting
	s2b103	Preceptors critique the students, they rarely—if ever—use phrases that imply fault or failure
	s2b104	Preceptors did not frame as errors, rather as less effective ways of doing things
		Instructors tended to give concrete feedback that was structured around the pre-specified objectives of the simulation
		End of the call, the instructor passes judgment ("complete" or "incomplete"; "pass" or "fail")
Bounding Question 2: What strategies and activities do instructors and preceptors use to provide feedback?		
	s2b201	I & P employ different strategies for monitoring, assessing, and prompting change in their learners, choosing different strategies to meet different learning goals
	s2b202	In the Core Skills drills, the instructor monitors all groups as they work through the scenario
	s2b203	Instructor intervenes to correct both individual problems and to address group concerns
	s2b204	Preceptors in the HFS setting provide feedback throughout the call in the form of coaching and mentoring

Table B2. Statements of finding sorted by research question and subquestion

Question	Finding ID	Findings
	s2b205	In-call feedback is opportunistic, occurring when instructors or preceptors note an issue or problem requiring intervention
	s2b206	Most common form of feedback in all simulations is the post-call "debriefs."
	s2b207	220, 253 post-call debriefs are often peer-driven, with instructors contributing when they are available
	s2b208	HFS has no formal debrief, thus the post-call debriefs are informal and varied in length and the depth of discussion
	s2b209	Variety of activities to provide feedback to the learners. Their feedback was either corrective or explanatory, including evaluation (feedback), tips (suggestion), questioning, and explanation
	s2b210	Suggestions and tips are the most common form of feedback, accounting for approximately 40% of all comments
	s2b211	Evaluative and directive comments combine for 22% of comments
	s2b212	Six % of the total comments are evaluative
	s2b213	Few evaluative comments are given by the preceptors
	s2b214	Instructors use primarily suggestions and alternatives in their feedback
	s2b215	Tips, suggestions, and alternatives are the most common form of feedback used by the preceptors
	s2b216	Preceptors provide correction as necessary and use questioning as a form of coaching to prompt and steer the students
	s2b217	Instructors and preceptors favour the use of facilitative approaches, most frequently framing corrective comments as suggestions and tips
	s2b218	Feedback given during the calls tends to use suggestions and questioning strategies to coach and guide the students
	s2b219	Post-call debriefing leans more to elaboration and explanation
	s2b220	Instructors and peers in the Classic Case simulations give more directive and evaluative comments than the preceptors in the HF simulations
	s3b301	Peer and instructor feedback was closely matched to the curriculum framework and focus of the learning activities in the JIBC Practice Ladder
	s3b302	Instructor and peer feedback is tightly focused on skills, procedure, and decision making related to protocols and treatments
		Able to code almost all feedback from the instructors comfortably into these categories
Bounding Question 4: Evaluation using traditional marking criteria: Do classroom criteria match to the feedback given by preceptors?		
	s4b301	Feedback was situational and based on their interpretation of the experience of the scenario
	s4b302	Preceptors called on how things are done "in-the-field" or how the preceptor would have acted

Table B2. Statements of finding sorted by research question and subquestion

Question	Finding ID	Findings
	s4b303	
	s4b304	Very situational—not preplanned, hard to pull categories
	s4b305	Twenty-one % of the items could be categorized into the Practice Ladder evaluation categories
	s4b306	Often listing one or more qualifications for choice of category
	s4b307	No apparent themes in preceptor feedback
	s4b308	Preceptor comments frequently speak to adaptation and contextual performance
	s4b309	No consistent pattern even on calls with similar problems
	s4b310	Situational aspect of the preceptors' comments is also evident in the apparently contradictory advice that they give
	s4b311	Advice given by each practitioner differs from the others, each situated within the context of the overall conversation and the calls in which the advice is being given
	s4b312	Relative absence of comments from the preceptors related to, or calling upon pharmacology and pathophysiology
Emergent Themes		
Bounding Question 5: How do instructors and preceptors target their feedback (this call, calls like this, etc.)?		
	s2b501	Peer and instructor feedback from the simulations in Core Skills and Classic Case was almost exclusively targeted on the call-at-hand
	s2b502	Call-at-hand was directive, in the form of suggestions, and targeted at specific tasks or functions
	s2b503	"In the field" comments call on past practice to support advice on how the students should perform in the future
	s2b504	Specific incident from their past rarely used during the simulations
Bounding Question 6: What elements or layers of the simulation environment do instructors and preceptors give feedback on?		
	s2b601	Peer and instructor feedback from Core Skills and Classic Case simulations is heavily focused on four areas: performance of the attendant, functioning in a simulation environment, call management, protocols, and principles of management
	s2b602	Peer and instructor feedback from Core Skills and Classic Case simulations is heavily focused on four areas: performance of the attendant, functioning in a simulation environment, call management
	s2b603	Preceptors' comments ranged widely
	s2b604	Largest concentration was on call management (24%)

Table B2. Statements of finding sorted by research question and subquestion

Question	Finding ID	Findings
	s2b605	Significant drop to areas such as patient as problem, interacting with other responders, use of equipment, and references to practice in the field (each between 9% and 10%)
	s2b606	Remaining feedback was distributed across almost all fields in the coding model
	s2b607	Instructors and peers made few or no comments relating to the immediate or broader physical environment of the simulations, other people in the simulations (bystanders, family, other responders), the curriculum, field practice, or social or cultural concerns
	s2b608	Preceptors tended to focus on discussions around call management, the patient as an instance representing a particular condition, and practice in the field
	s2b609	Preceptor feedback is very idiosyncratic and situational
Bounding Question 7: how does type of advice relate to context of advice given?		
	s2b701	Coding framework provided useful distinctions between the feedback given by peers, instructors, participants, and preceptors
	s2b702	Peer feedback in the Core Skills and Classic Case simulations was focused almost entirely in the Novice and Advanced Beginner categories
	s27603	The Classic Case instructor comments are also heavily weighted to low context factors, with 63% of the feedback focused on rules and principles
	s27604	Yet, fully a quarter of the instructors comments are encouraging students to choose between acceptable alternatives based on contextual factors at Dreyfus' Proficiency level
	s27605	The preceptors, in contrast, provide comments seeking competence, proficiency, and expertise
	s27606	Half of the preceptor comments focus on adaptation, situational discrimination, and experience-based decision making
	s27607	End-of-day discussion are even more heavily weighted to consideration and discussion of contextual and experience-based factors
Awareness of other factors		
	s2b401	Missing social and cultural factors in reports/discussion
	s2b402	Uneven discussion in debriefs
Call to Truth		
	s2b501	Instructors used more clinical science and curr than preceptors
	s2b502	Preceptors almost exclusive use of non-formal sources of authority

Table B2. Statements of finding sorted by research question and subquestion

Question	Finding ID	Findings
	s2b503	"Generalized, non-attributable principles of management"
	s2b504	Forty % of instructor feedback was related to equipment, call management, protocols, and treatment
	s2b505	Rationale and justification for this feedback draws on curriculum material and training protocols
	s2b506	Preceptors give much more situational feedback, focusing on a range of topics so broad it was difficult to categorize
	s2b507	Most preceptors gave advice that either varied from or contradicted formal policy and protocols
	s2b508	Eighty-two % of the feedback in the Classic Case debrief sessions call to curriculum materials and curriculum protocols for justification
	s2b509	Five % of the feedback given calls on informal sources of authority (experience, general practice in the field, and generalized principles of management).
	s2b510	Preceptors' feedback is strongly supported by experience, field practice, and generalized principles of management
	s2b511	Preceptors call upon the unique needs of the patient for 20% of the feedback they give during the calls, and 14% in their post-call feedback
	s2b512	During the calls, the preceptors' feedback tends to call upon generalized principles of management and adapting to the unique needs of the patient at hand (51%)
	s2b513	Post-call discussions and debriefs, the preceptors tend to focus less on the specific patient and more on general issues. This is reflected in calling less to the unique needs of the patient and principles of management (23%) and more to the preceptor's personal experience and references to "how things are done in the field" (55%).
	s2b514	Feedback is overwhelmingly based on informal sources of authority (75% for in-call and 80% for post-call)
	s2b515	Clinical science is rarely used to support feedback from either the instructors or the preceptors
Sub Question 3: how do learners structure and present their experiences in HFS?		
Introduction		
	s3b101	None followed report exactly
	s3b102	Vitals and tx in almost all
	s3b103	Others missing hx, background
	s3b104	No useful data found
Bounding Question 2: What evidence is there of the presence of a provisional diagnosis (absent, translated, implied, explicit)?		
	s3b201	Split: verbatim, translated, paraphrased, implied, explicit

Table B2. Statements of finding sorted by research question and subquestion

Question	Finding ID	Findings
	s3b202	No useful data found
Bounding Question 3: What evidence is there of the use of medical terminology and diagnostic language?		
	s3b301	19/30 translated patients' words
	s3b302	Several more used descriptive terminology and paraphrased, but did not explicitly use diagnostic language
	s3b303	No useful data found
Bounding Question 4: What evidence is there of the use of clinical reasoning strategies?		
	s3b401	21/30 critical hx
	s3b402	Two required prompting from triage, 4 others weak
	s3b403	8/30 key features
	s3b404	6/30 used pertinent positives and negatives
	s3b405	17/30 did translate into diagnostic language
Bounding Question 5: What evidence is there of the inclusion of information or description of interpersonal, physical, personal, social, or cultural aspects of the experience		
	s3b501	No data found on PCRs
	s3b502	Students' focus on their patients' medical presentation
	s3b503	Few instances of references to personal, social, cultural aspects in reports
	s3b504	Bystanders and family are often not recognized as potential information sources
Bounding Question 6: How do participants label and categorize calls in post-simulation interviews and discussion?		
	s3b601	Tended to label by dispatch category; tried several reframing questions to consider alternative categorizations
Emergent theme: What are the apparent organizing forms and structures used in delivering reports?		
	s3b701	No reports directly followed formal reporting structures
	s3b702	Noted several types of reports based on organization and underlying structure:
Sub Question 4: how is learner's own sense of developing CCCJ in HFS		
Bounding Question 1: How do learners modify their performance in subsequent calls/sims based on feedback from prior sims?		
	s4b101	Limited or no discussion of ongoing issues.

Table B2. Statements of finding sorted by research question and subquestion

Question	Finding ID	Findings
	s4b102	No apparent trends in performance across sims
Bounding Question 2: How does learners' statements of their performance match that of their preceptors and instructors?		
	s4b201	No useful data found
Bounding Question 3: What evidence is there of learners monitoring and reflecting on their own performance in informal discussions and actions?		
	s4b301	No useful direct data found
	s4b302	In the post-simulation interviews, several students noted that having the other responders was one of the high points of the day for them
	s4b303	, In subsequent interviews, the participants indicate that they were aware of the environment and acknowledged that exposure to the rich settings provided valuable experience
Bounding Question 4: What causes aporias and errors in learners' performance?		
	s4b401	See table: flaws in the matrix; unfamiliarity with mannequins, moulage
	s4b402	Thirty % of these instances involved situations where there was uncertainty or a flaw in the physical or physiological fidelity of a patient's presentation
	s4b403	Thirty-seven % were instances of a participant seeking information or clarification on an assessment finding, and discussions on the mechanics of performing a simulation
	s4b404	Immersion of the experience also changes when either call managers or preceptors intervene to redirect or prompt students
Bounding Question 5: What evidence is there of learners' monitoring and reflecting on their own performance in debriefs?		
	s4b501	No useful data found
Bounding Question 6: What evidence is there of learners' monitoring and reflecting on their own performance in interviews?		
	s4b601	Immediately after the HFS modules, over 38% of the students' comments were in the Novice and Advanced Beginner categories
	s4b602	In the follow-up interviews several months later, the students only gave 7% focused on Novice and Advanced Beginner items
	s4b603	Eleven % of the post-HFS comments are aimed at proficiency, while 55% of the subsequent interview comments are focused on issues relating to proficiency and expertise
Bounding Question 7: What types of decisions do participants make in the simulation environment?		
	s4b701	Majority of interactions in the HF simulations involved the attendant, patient, partner, and preceptor
	s4b702	Interactions in the classroom simulations, in contrast, were focused on the attendant, patient, and equipment

Table B2. Statements of finding sorted by research question and subquestion

Question	Finding ID	Findings
	s4b703	Some classroom simulations involved extensive interactions between the attendant and partner. However, these interactions were usually limited to specific points in the call
	s4b704	Partners in classroom simulations are relegated to watching and acting under direction
	s4b705	HF simulations, the partners were not only active throughout the call, but their interactions were a mix of acting under direction, acting collaboratively, and acting independently
	s4b706	A common form of interaction between partners in the HF simulations is discussion
	s4b707	Few instances in the HF simulations of partners either intervening to redirect the attendant or participating in discussions regarding differential diagnoses
	s4b708	Drivers provide very little in-call feedback or advice to their partners
	s4b709	Discussions that focus on clinical reasoning tend to occur between the attendant and the preceptor
	s4b710	Attendant and driver, however, collaborate and discuss a myriad of “little decisions” throughout the simulations
	s4b711	Attendant and driver solve “little problems” involving the choice or adaptation of procedures to the unique context of the call
	s4b712	Often, the simulations are punctuated by sudden bursts of collaborative discussion and activity, usually centred around “packaging” the patient or the performance of a complex task such as spinal management or fracture management
	s4b713	Participants in the HF simulations in this study engaged in shared decision making and collaborative activity.
	s4b714	However, most of their interactions involved multiple ongoing “little” decisions—from coaching and suggesting alternatives to discussing potential next actions
	s4b715	Decisions were further embedded in activity—in many cases, it was difficult to “break apart” the discussion and action
	s4b716	Seems that the participants are learning to participate in activities that are more than the sum of their individual contributions
Bounding Question 8: What evidence of clinical reasoning is in their decision making		
	s4b801	Over 50% of the reports I coded were presented in a rote fashion or with minimal or missing information
	s4b802	Theiry-seven % of the reports identified a clear provisional diagnosis
	s4b803	Forty-eight % merely reported or paraphrased the patient’s description of the event as the chief complaint or diagnosis
	s4b804	% Of the reports presented the chief complaint as a provisional diagnosis and identified other potential differential diagnoses

Table B2. Statements of finding sorted by research question and subquestion

Question	Finding ID	Findings
	s4b805	Using the procedures of clinical reasoning to gather appropriate data, but were not engaging with it as a process for problem-solving
	s4b806	Only 8% of the feedback given by preceptors in the HF day was directly related to the use of clinical reasoning or analytic reasoning strategies
	s4b807	Preceptors did intervene during the calls to coach the students in the use of clinical reasoning
	s4b808	Preceptors commented that students come out of the program with strong skills, but have tunnel vision when it comes to diagnosing patients
	s4b809	What the preceptors view as tunnel vision (from the perspective of a field practitioner) may simply be students doing what normally works (from the perspective of the classroom environment)
	s4b810	Students in this study seem to be employing non-analytic strategies as novices
Bounding Question 9: How is shared decision making evident in HF environment?		
	s4b901	In the HF simulations in this study, the participants do engage in shared decision making, but the focus tends to be multiple ongoing “little” decisions of what to do next and how to do it
	s4b902	Patterns of mutual support and interaction emerge as participants work together in activities that are more than their constituent parts
	s4b903	Blending of speech / action implies that functioning as a paramedic is a way of knowing that exceeds its kinaesthetic & verbal description, & that learning is more a process of becoming than an internalization of discrete skills and knowledge

Table B3. Coding categories for relating feedback to the Dreyfus' (2001) model of skill acquisition

Code	Definition or description	Feedback example
Novice		
Context free features	Elements of a situation that can be recognized without previous experience in the task domain	If the blood pressure is below 90/50, treat the patient as hypotensive
Rules	Context independent rules based on context-free features	If blood pressure is below 90 mmHg systolic, do not administer nitroglycerine
Advanced beginner		
Situational Aspects	Features of a situation that are meaningful within a specific context; requires some experience to distinguish aspects from features.	Pallor (pale, cool, clammy skin), which may indicate shock with a history of trauma, or may indicate fright or anxiety in an emotionally charged environment.
Principles/ Maxims	Procedures based on both situational aspects and non-contextual features; requires some understanding and experience to apply.	Position hypotensive patients supine unless this might aggravate other conditions such as shortness of breath.
Competence		
Aspects with importance - salience	Number of relevant factors becomes overwhelming, and practitioner must determine which are most salient or important features of a particular situation.	An elderly male with a cardiac history who complains of sharp shooting pain in his left arm may have a musculoskeletal condition or be having a cardiac episode. Must decide which is more salient—the description of the pain (MS) or age and cardiac history (cardiac)
Develop a plan or perspective	Development of a treatment plan or approach to a situation based on choosing which aspects of a situation are most salient *in this case*	Either choose to manage as cardiac chest pain or choose to manage as a musculoskeletal condition. Note that while choice is based on salience, action is dictated by principles and rules.
Proficiency		
Situational discriminations	Intuitive recognition of situation and identification of salient features based on multiple past similar experiences.	A pedestrian struck by a car who has a single long-bone fractures of the lower leg and upper arm, but is lying on the pavement during evening rush hour in a cold, wet environment with light rain. Practitioner must consider mechanism of injury, nature of injury, physical safety, and environmental factors to determine whether to move the patient quickly from the scene or perform a thorough assessment and stabilize the fractures to prevent aggravating the injuries.
Decide based on salience	Must choose between multiple acceptable options, based on discrimination between salient features. May adapt principles to meet conflicting salient features.	Either choose to treat the patient as stable and splint before moving ***or*** choose to treat the patient as unstable with minimum stabilization on scene, with further assessment and splinting once patient is in ambulance. Either is acceptable and defendable.
Expertise		
Vast repertoire of intuitive perspectives	Intuitive recognition of situations and appropriate plans/perspectives based on a "bank" of previous examples and experiences	Function of experience, either in the field or in simulation.
Subtle and refined	Distinguishing of subclasses of types of	Discussion based on diagnostic and

Table B3. Coding categories for relating feedback to the Dreyfus' (2001) model of skill acquisition

Code	Definition or description	Feedback example
discriminations	experiences based on experience.	situational categories rather than body system or mechanism of injury; preceptor at man down call where patient is abusive, who intuitively recognizes potential for violence.
Intuitively appropriate action	Immediate, intuitive, situational response.	Preceptor in above situation who, without apparent thought, intervenes to ensure scene safety by cuing police officers to situation, positioning himself to block if patient starts kicking, and eventually intervenes to take over assessment of the patient from the students.

Table B4. Coding categories for interaction of participant and simulation environment

Code	**Definition**
01_Self	Talking to self, verbalizing procedures or decision making, thinking
02a_Concept of problem	Focused internally on the mental conception of the injury or condition, or on the internal script of the procedure. While participants are acting in simulation, they seem more like they are rehearsing than experiencing the moment.
02b_Patient–problem	Interaction with patient, but focused on immediate problem, injury, condition, e.g., patient assessment or treatment activities related to immediate or presenting problem. DOES NOT INCLUDE exploring issues unrelated to presenting problem.
03_Patient–person	Interaction dealing with patient about issues not directly related to presenting problem. Exploration of life history (rather than health history), dealing with house, relatives, pets, etc.
04a_Equipment	Interaction or use of paramedic equipment, such as jump kit, stretcher, AED, oxygen, etc.
04b_Immediate environment	Interaction with physical environment that is in the immediate range of the patient location. Usually about a 5 meter radius around the patient, or the area that the crew can deal with without getting up and walking. Includes looking for physical clues such as medication bottles, mechanism of injury, location of patient, etc.
05_Partner	Interaction with partner (for attendant, interactions with driver; for driver, interactions with attendant).
06_Preceptor	Interaction with the preceptor.
07_Other responders	Interaction with other responders, such as police officers, fire crew, lifeguards, triage nurse. Does not include civilians rendering aid or bystanders.
08_Other people	Interaction with family members, bystanders, onlookers.
09_Broader environment	Interaction with environment beyond immediate working radius of the patient. Includes checking weather, physical location, house and yard (if patient is in a specific room), etc.
10_Call manager	Interaction with instructor who is stage managing the simulation. Usually request for verbal information representing data that is not physically available to the crew—abnormal vital signs on an actor (e.g., actor portraying multi-trauma patient with low blood pressure).

Table B4. Coding categories for interaction of participant and simulation environment

Code	Definition
11_Simulation	References to the simulation as a learning activity, rather than as an experience of an (simulated) ambulance call. For instance, asking the preceptor or call manager what they thought the intent of the call was.
12_Curriculum	References to students` program or course material. For example, discussion on differences between field protocol and training protocol.
13a_Field practice	References to field practice. For example, discussion on how a particular procedure or type of call is done "in the field."
13b_Social setting	Interactions or references to the patient's social setting, such as relationships with family (e.g., history of domestic violence), socio-economic circumstances, ability to cope on own (for elderly patient), etc.
14_Cultural setting	Interactions or references to cultural practices or factors (gender, ethnicity, professional cultures).

Table B5. Coding categories for functions of the participants in the simulations

Code	Definition
Attendant Codes	
Assessing	Performing assessment functions such as asking questions, looking at scene, inspecting, palpating, or auscultating for physical signs.
Treating	Performing treatment actions, such as opening the patient's airway, placing gauze on a wound, applying pressure to control bleeding, starting a peripheral IV, etc.
Watching	Not actively engaged in the ongoing activity of the call. Watching as an observer, not as a participant. Does not appear to be expecting to take on tasks or activities.
Thinking	Appears to be reviewing case, considering options, making decisions, etc. May be internal or may be verbalizing.
Pausing	Appears to be disengaged from the activity of the call, but does not appear to be thinking or making decisions about the call.
Describing	Giving an explanation of decisions or describing actions or findings to the preceptor.
Reporting	Giving or receiving patient report.
Directing	Directing activities of other participants in the scenario—for example, asking partner to put oxygen on the patient or asking preceptor to help prepare the stretcher.
Seeking information	Asking for information that is not available or is apparently contradictory to what attendant is seeing in the scenario. For example, with a conscious actor who is portraying a patient in shock, asks Call Manager for blood pressure reading.
Seeking confirmation	Obtains information from the scene and verbalizes it, as though asking the Call Manager to confirm that the stated findings are what should be found in the scenario. For example, when mirroring an action, such as taking a blood pressure, the participant will call out the reading she/he obtains, expecting the Call Manager to either confirm this as the "real" reading for the scenario or providing the desired reading as verbal information.
Collaborating	Performing activities in collaboration with another participant in the scenario—usually patient care related activities such as preparing the stretcher, securing splints, performing a spinal roll, etc. Participants are not acting under direction (e.g., attendant tells partner what to do step-by-step), rather they are performing a known procedure in a collaborative manner.
Acting under direction	Completing a designated task. Usually, the attendant acts under direction when the preceptor intervenes in the call or when an Advanced Care Paramedic crew takes over control of the call.
Discussing	Disengaged from activity in the call to discuss some aspect of it. Or, alternatively, discussing the call in the post-call debrief session.
Verbalizing steps	Verbalizing performance of a procedure. May be done while actually performing the procedure (using the verbal "checklist" as a mental scaffold to guide performance) or as a

Table B5. Coding categories for functions of the participants in the simulations

Code	Definition
	way of "completing" an activity that cannot be performed in the scenario (starting a peripheral IV on an actor).
Partner Codes	
Other	
Watching Waiting	Not actively engaged in the ongoing activity of the call. Watching as an observer, not as a participant. Does not appear to be expecting to take on tasks or activities.
Acting under direction	Completing a designated task as directed by the attendant, preceptor or Advanced Care Paramedic crew.
Acting independently	Completing activities without direction or consent of the attendant. Showing initiative to perform required tasks or to complete preparatory tasks for a procedure that will need to be done in the future (preparing the stretcher).
Discussing	Disengaged from activity in the call to discuss some aspect of it. Or, alternatively, discussing the call in the post-call debrief session.
Suggesting	Intervening to suggest an activity or alternative way of performing a procedure.
Acting collaboratively	As above.
Reporting	As above.
Directing	As above.
Preceptor Codes	
Other	
Watching	As above.
Prompting	Providing hints, suggestions, or comments meant to prompt participant into taking a particular action or reaching a specific conclusion.
Coaching	Providing direction or encouragement, or showing and guiding performance of a particular procedure.
Directing	Intervening to direct participant to perform a specific task or to provide what preceptor feels is appropriate decision.
Intervening	Physically intervening to start performing actions and taking control of the call. Differs from parallel or additional activity by being directive of other crew members. Preceptor has assumed decision making functions for the team.
Parallel or additional	Physically performing activities or actions in parallel to the remainder of the crew. Does not intervene to redirect or control other members. Rather, completes functions that the preceptor feels need to be taken on.
Discussing, collaborating	Either engaged in a discussion (e.g., giving feedback) or performing activities in collaboration with another participant in the scenario—usually patient care related activities such as preparing the stretcher, securing splints, performing a spinal roll, etc. Participants are not acting under direction (e.g., attendant tells partner what to do step-by-step), rather they are performing a known procedure in a collaborative manner.
Acting as directed	As above.
Acting independently	As above.

Table B6. Coding categories for autonomy of partners' actions

Code	Definition
Other	
Watching Waiting	Partner is not engaged in activity, but appears to be watching and waiting for further direction.
Acting under direction	Performing actions as directed by the attendant.

Acting independently	Initiating activity without consultation or direction from partner.
Discussing	Engaged in discussion about the call.
Suggesting	Making suggestions or providing feedback to partner.
Acting collaboratively	Working with partner to perform some procedure (e.g., securing patient to stretcher, performing spinal rolls, etc.).

Table B7. Coding categories for procedural fidelity

Code	Definition
Attendant Codes	
Personal	Performing non-simulation related activities.
Actual	Performs actual task in authentic manner using appropriate approach.
Mirroring	Performs actual task and verbalizes findings. Call manager validates or substitutes findings with “real” findings for the scenario.
Miming	Physical mimicry or gesturing that indicates performance of a procedure that is being verbalized. May range from simple hand gestures that accompany statement that participant is “doing a physical exam” to detailed use of performing a procedure, such as going through the motions of starting an IV without actually inserting an intravenous catheter.
Verbalizing	Describing the performance of a procedure.
Thinking	Paused and momentarily disengaged from the activity around the participant while apparently thinking (e.g., trying to decide what to do next or considering options).
Discussing	Engaged in conversation with the participant’s partner or the preceptor. Not engaged in the performance of the simulation, but “out of” or “above” the call, discussing some aspect of the experience.
Practicing	Performing a task in rote fashion, sometimes accompanied by verbalization of the steps required to complete the task. The participant appears to be practicing the task—focused on the task itself—rather than on performing the task within the context of the overall simulation or call.

Table B8. Coding categories for cognitive focus

Code	Definition
00_Concept of call	In this mode, the student appears to be engaged with a mental conception of how the call should be occurring. The engagement with the physical environment appears to be almost a rehearsal of an internal script.
00_Personal	Participating in activities or discussion that is outside the role of student or practitioner.
01_ In the call	The participant is immersed in the moment and appears to be participating in "real" event. Her/his actions are seamless and she/he does not seem to acknowledge or be aware of the camera, call manager, or factors not associated with the simulation event.
02_ In the simulation	Participants are aware that they are participating in simulation, and obviously “role playing.” Often indicated by verbalizing actions or findings or asking actors/call managers for findings: “do I find a radial pulse?” Participants may be making references to simulation or course, or interacting with other participants in a manner that makes it apparent that they are “acting” rather than experiencing the event.
03 _In the day	Participants are interacting or discussing facets of the experience in the context of the overall simulation day, not necessarily immersed or participating in a call or simulation. Includes references or discussions about the mechanics of the day, functions or roles of participants, etc.
04_In the program	Participants are discussing or interacting with reference to their roles as students or faculty

	in the PCP program.
05_In career	Participants are discussing or interaction in context of their overall career or practice.

Table B9. Coding categories for apparent source of authority for feedback

Code	Definition
Unique needs	Justification based on the unique needs of this patient. The feedback focuses on how a procedure or approach should be modified based on the situation at hand.
Unattributed general principles of management	Statements are made without an explicit or implied source of authority, such as "always assume that an unconscious patient will wake up swinging." These statements are generally framed as principles or generalizations that apply to a range of situations similar to the one at hand. This category does not include statements that are obvious paraphrases or quotes from formal sources, such as statements regarding indications or steps in a protocol or treatment algorithm. May represent tacit knowledge.
Patient assessment	Justification situated on the patient assessment model. Usually applied to procedural statements about when to perform a particular procedure or what order activities should be performed in.
Curriculum, formal Principles of management	Quotes or references to formal sources of authority, such as PCP curriculum material such as texts, PCP Principle of Management job aids, hand outs, etc.
Curriculum protocols	Quotes or references to the PCP training protocols, which are a series of treatment algorithms for common injuries and conditions. These comments distinguish between the protocols used in training and those used in an operational setting.
Field (operational) protocols	Quotes or references to the BCAS operational protocols. These comments distinguish between the operational protocols and those used by students in training.
General practice in the field	References to "how things are done in the field"—particularly when used as justification for performing a procedure differently than it is documented or taught in the curriculum.
My experience	References to the personal experience of the speaker or "my way" of doing things. Often framed as alternative approaches or ways of modifying general principles based to suit the speaker's preferences or experience, such as "I find it easier to roll the patient away from you."
Clinical Science	Calls for justification from underlying anatomy, physiology, pathophysiology, and/or pharmacology. Often framed or presented as a question, such as: "how is a narcotic overdose going to affect breathing?" or as part of a series of statements explaining or justifying a particular treatment choice or diagnosis.
Situational Awareness	References to the development of situational awareness through experience, such as: "you have to learn to recognize when a scene doesn't feel right."
How simulations work	Justification based on the mechanics of performing in a simulation environment, such as: "you have to tell me what you are thinking here" or "you tell me what you are getting for a blood pressure and I'll tell you if it's different." Most often used early in the program, or during the first couple of simulations in the high fidelity day.
Image of the professional	Calls for justification based on a largely unspoken concept of what an experienced paramedic would be expected to do.