PERSONAL EPISTEMOLOGY AND APPROACHES TO LEARNING IN MEDICINE

A CASE STUDY OF SECOND-YEAR MEDICAL STUDENTS

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ABSTRACT

Personal epistemology addresses "the theories and beliefs that individuals hold about knowledge and knowing and the way in which such epistemological perspectives are related to academic learning" (Hofer, 2004, p. 120). Hofer and Pintrich (1997) proposed that personal epistemological theories consist of two constructs: the nature of knowledge and the nature of knowing. These constructs are hypothesised to exist on a continuum ranging from naïve to sophisticated epistemological beliefs. Personal epistemology is particularly applicable to medical students in a problem-based-learning (PBL) program, as it emphasises self-directed learning, as "beliefs about knowing and knowledge are potentially important determinants of intellectual performance" (Kuhn, Cheney & Weinstock, 2000, p. 309). There is a paucity of studies in the medical education literature on personal epistemological beliefs (Knight & Mattick, 2006). Roex and Degryse (2007) argue that "insights into students' epistemological beliefs have yet to find their way into the curriculum" (p. 616). Savin-Baden (2000) reported that "students' voices are largely missing from the literature on problem-based-learning, key elements such as learning context… are rarely acknowledged" (p. 26).

The aims of this study was to investigate how personal epistemological beliefs were conceptualised by medical students at the end of their first two years in a PBL medical program; whether their beliefs evolved over the first two years and were related to the process of learning; and whether they differed between students from the lowest and highest ranked academic groups.

A qualitative research design framed this investigation. A series of interviews were conducted with 12 second year medical students selected according to a maximum variation purposeful sampling technique (Patton, 2002). The participants represented the highest and lowest academically ranked in their year. Interview transcripts were analysed using a combination of thematic analysis, the constant comparison approach, and a personal epistemological theory framework. The results were presented as thematic narratives constructed on the students' retrospective experience of learning over the first two years of medical school. Narratives are well-suited to reporting these qualitative results to "link audience, text, structure, empirical inquiry and lived experience" (Denzin, 1997, p. 244).

The findings revealed that students' prior learning experiences in high school had a major impact on their epistemological interpretations of the medical program. There was a pattern of epistemological beliefs between the two groups of students. Students from the lowest ranked group retained naïve epistemological beliefs after two years. These students misinterpreted the constructivist curriculum and their approach to learning was disabling. Students from the highest

ranked group demonstrated sophisticated beliefs. These students struggled with the transition to the medical program but turned these into opportunities for epistemological development. These results provide an epistemological explanation for why some students struggle, and will continue to struggle, based on their prevailing epistemological beliefs. The findings also suggested that the constructivist PBL approach was a major influence on the development of students' epistemological views, and that a constructivist PBL medical program can accelerate students' epistemological development.

DECLARATION

I certify that this work contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. In addition, I certify that no part of this work will, in the future, be used in a submission for any other degree or diploma in any university or other tertiary institution without the prior approval of the University of Adelaide.

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CHAPTER 1: INTRODUCTION

Background

This study began as an investigation into undergraduate medical students' experiences of self-evaluation in a medical program with a problem-based-learning (PBL) philosophy. This was an important area to investigate due to the increase of PBL in medical schools and the expectations that learners be more self-directed. The theoretical basis of the cognitive constructive approach to PBL (Schmidt, Rotgans & Yew, 2011) also requires a sophisticated level of elaboration and integration of a complex knowledge and understanding across the multi-disciplinary areas in medical training.

It is important to acknowledge that the medical program is the first phase in a profession where training takes between 6-12 years and espouses life-long learning skills. Therefore, it was worthwhile to investigate students' experience in the early years of medical school with the purpose of identifying areas of difficulty that can be remediated at the earliest opportunity.

Hence, this study focused on the experience of students who were the lowest academically ranked in their year and compared them with the highest ranked to identify any patterns of significance. However, in the interviews conducted in this study, students not only expressed their difficulties with self-directed learning, but these were usurped by difficulties in *learning how to learn* in medical school as a result of their existing beliefs about knowledge and knowing from high school. Therefore, the study developed into a broader theoretical investigation of the concept of knowledge and knowing and its relationship to learning in the medical program. Subsequently, the interpretive research design enabled the study to refocus on the body of research of epistemological development, which addresses:

> How individuals come to know, the theories and beliefs they hold about knowing, and the manner in which such epistemological premises are a part of and influence the cognitive processes of thinking and reasoning (Hofer, 2000, p. 378).

Relevance of Personal Epistemology to Medical Education

Personal epistemology is particularly applicable to the continuing educational and intellectual development of medical students, as it emphasises independent learning as "beliefs about knowing and knowledge are potentially important determinants of intellectual performance…what people believe about the acquisition of knowledge – how it occurs and what it accomplishes – influences its operation in their own lives" (Kuhn, Cheney & Weinstock, 2000, p. 309). In medical education literature, there is little reference to epistemological beliefs as Roex and Degryse

(2007) point out: “although much energy has been spent on revolutionary curriculum changes in medical school…insights into students’ epistemological beliefs have yet to find their way into the curriculum” (p. 616).

Furthermore, in PBL curricula there is a fundamental change from the traditional role of the teacher as the transmitter of knowledge to the PBL tutor as the facilitator of the learning process. Savin-Baden (2000) reported that this can cause disjunction, which is defined as “a sense of fragmentation of part of, or all of, the self, characterised by frustration and confusion and a loss of sense of self, which often results in anger and the need for right answers” (p. 149). Savin-Baden (2000) also reported on the lack of studies into what transpires in this curricula, citing students’ “voices are largely missing from the literature on problem-based learning, key elements such as learning context, learner identity and ‘learning in relation’ are rarely acknowledged” (p. 26).

There is also limited evidence to explain what fosters epistemological development, or the alteration of epistemological beliefs in the learning context (Hofer, 2001). Furthermore, the authors of a landmark review of personal epistemological theories (Hofer & Pintrich, 1997), claim: “we know little about the development progression of epistemological theories across educational settings and what the epistemological issues might be in individuals making the transition from…high school to college” (p.132). Hofer and Pintrich (1997) recommended that researchers focus on gathering naturalistic evidence in context, as “these transitional periods provide opportunity to examine both individual cognitive-development factors as well as contextual opportunities and constraints that influence the development of personal epistemological theories” (p. 132). The research design of this study enables this focus.

Aims of this Study

The aims of this study was to explore how epistemological beliefs were conceptualised by medical students at the end of their first two years in a PBL medical program; whether their beliefs evolved over the first two years and were related to the process of learning; and whether they differed between students from the lowest and highest ranked academic groups. The study addressed five questions:

1. What were the patterns of epistemological beliefs between the highest and lowest ranked students in this study?
2. How did students’ epistemological beliefs evolve over the first two years?
3. What were the epistemological components in the educational environment that students experienced, made sense of, and were most salient?

4. How were these epistemological components interpreted by the students within the four dimensions of personal epistemological beliefs?
5. How did the epistemological beliefs held by students relate to the process of problem-based-learning?

Significance

This research will contribute to the developing field of epistemological research in higher education and, in particular, medical education. The naturalistic setting of this research, the complex nature of knowledge within the multi-disciplinary educational base of medicine, coupled with the meta-cognitive learning style required by students in a problem-based learning curriculum contribute to the uniqueness of this study. No previous research has taken a phenomenological approach to investigate how epistemological beliefs held by medical students are related to the process of learning in the context of a problem-based learning medical degree and how students adapt to learning in the early years of medical school. The intention of the study is to identify patterns that were present early at medical school that are enabling the process of learning and assist with the transition from high school to medical school, and to provide an epistemological explanation for the large variance in academic results at the end of first-year medicine. Within this goal, the epistemological beliefs held by students at the lowest end of the academic scale will be explored, as this is of the utmost importance to the education of future medical students.

Structure of the Thesis

The literature review (Chapter 2) explores the relevant models of personal epistemology applicable to this study. Chapter 3 describes the research design and the narrative methodology used in data collection. As this study is centred on the epistemological beliefs of students, their voices are introduced through brief vignettes in Chapter 4. These vignettes provide the contextual framework for each of the students. Chapters 5, 6 and 7 describe the epistemological beliefs of students in the context of high school, years 1 and 2 of medical school, and in a PBL case environment, which is the learning approach used to study medicine. Chapter 8 concludes the study with further discussion, responses to research questions, limitations, and recommendations for further research. Table 1 outlines the thesis structure.

Table 1 Structure of the Thesis and Chapter Outlines

Chapter 1	Introduction Background, aims and significance of this study. Introduction of the concepts of personal epistemology (beliefs about knowledge and knowing) and their relevance to medical education.
Chapter 2	Literature Review Definition of Epistemology and Personal Epistemology. Review of Development Models of Personal Epistemology. Introducing the theoretical constructs of Personal Epistemology. Personal Epistemology in Medical Education.
Chapter 3	Research Design Outline of the Interpretivist Research Paradigm of this case study.
Chapter 4	Student Vignettes Introducing the voices of a range of students in the study.
Chapter 5	Epistemological Reflections on High School in Making Sense of Medical School Outline of the high school learning environment and the nature of academic tasks. Analysis of students' perspectives on the nature of knowledge and knowing in high school, which influenced their transition to medical school.
Chapter 6	Epistemological Views in the Context of the Medical Program Outline of the medial program environment and outline of the theoretical basis of problem-based learning and the nature of the academic tasks. Analysis and interpretation of students' perspectives on the nature of knowledge and knowing as they adapt to the first two years of the medical program.
Chapter 7	Epistemological Perspectives in the Context of a Problem-Based-Learning Case Analysis and interpretation of students' 'think out loud' process of working through a problem-based learning case. Comparison of personal epistemological theory and the cognitive constructive theory of problem-based learning.
Chapter 8	Conclusion Summarising the results of the study and addressing the main aims. Limitations and recommendations and directions for future research in personal epistemology and medical education.

CHAPTER 2: LITERATURE REVIEW

Introduction

This chapter defines the terms *epistemology* and *personal epistemology* and reviews the major theories of students' epistemological development in higher education. Epistemological research began with William Perry's (1970) landmark study conducted using qualitative research methods. Subsequent studies continued this approach and described students' development as a series of epistemological stages, thinking, positions, or perspectives. As reported by Richardson (2013), "well validated quantitative instruments…to measure epistemological development in large samples of students are still lacking" (p. 191). Therefore, the principal focus of this chapter is an in-depth review of the four foundational studies on the concepts of personal epistemology (Baxter Magolda, 1992; Belenky, Clinchy, Goldberger & Tarule, 1986; King & Kitchener, 1994; Perry, 1970) and subsequent studies which were informed by this body of research. This is followed by an overview of the theoretical framework of the dimensions of personal epistemology, which Hofer and Pintrich (1997) proposed to "clarify the research and thinking in this area" (p.133). This conceptual framework was selected to inform the analysis in this study. Finally, studies relating the concept of personal epistemology to medical education are reviewed.

Personal Epistemology

Epistemology is a philosophical construct, and personal epistemology involves an application of this concept at an individual level. Classical epistemology is a branch of epistemology philosophy that deals with the nature and study of knowledge, including the source of knowledge and its truth value. The term *epistemology* was first introduced by the Scottish philosopher James Frederick Ferrier (1808-1864). It answers the general question, "What is Knowing and the Known" or "What is Knowledge?" (Oxford English Dictionary). The term *personal epistemology* was defined by Hofer and Pintrich in 1997, who described personal epistemology as an application of the concept of epistemology at an individual level. Specifically, this refers to how individuals view the nature of knowing and knowledge and its limits and justification (Hofer & Pintrich, 1997).

Research on the nature of personal epistemology has diversified with investigations in different disciplines, namely education and psychology. Neissen (2002) cautions that, while the expansion of research is promising,

> [t]he successes partly mask the fragmentation of the field that is evidenced by the plethora of disparate labels used to indicate epistemological commitment: epistemological beliefs, epistemological thinking, epistemic cognition, epistemological theories, ways of knowing,

epistemological posture, epistemological reflection, epistemological stance, epistemological resources and epistemological repertoires. (p. 40)

Irrespective of the term/s used, the research encompasses the understandings that individuals hold about knowledge and how they come to know what they know.

In the field of higher education, research on personal epistemology can be placed into two areas: 1) Epistemologies as a Development Model, and 2) Epistemologies as a Set of Beliefs. Within the Developmental Model approach, researchers have created a number of one-dimensional models, each with different stages or perspectives, and which describe students' progression from simple (naïve) to more complex (sophisticated) beliefs pertaining to the nature of knowledge and knowing. Research in the Set of Beliefs approach challenged the idea of a one-dimensional model, and proposed an epistemological belief system in which there were several dimensions to personal epistemology. These dimensions could develop independently of each other and could develop at different rates. For example, a person could simultaneously hold both a naïve and a sophisticated belief at the same time on any one dimension in a given domain of knowledge.

Models of Epistemological Development

The four foundational models of epistemological development which have informed this field are:

1. Perry's Scheme of Intellectual and Ethical Development. (Perry 1970)
2. Women's Ways of Knowing. (Belenky, Clinchy, Goldberger & Tarule, 1986)
3. Epistemological Reflection Model. (Baxter Magolda, 1992)
4. Reflective Judgment Model. (King & Kitchener 1994)

The focus of each researcher and the corresponding labels or terms used to describe their epistemological studies are summarised in Table 2. This table illustrates the alignment of each stage or position with respect to each of the other models and highlights the difference in epistemological terms used within this field of personal epistemology for these four models.

Table 2 Models of Epistemological Development

Researcher/s	Perry	Belenky et al.	Baxter Magolda	King & Kitchener
Main focus of research in epistemology	Intellectual and ethical development	Women's ways of knowing	Epistemological reflection	Reflective judgment
Term used by researcher	Positions	Epistemological perspectives	Ways of knowing	Reflective judgment stages
No. of stages/ positions, etc.	9 positions within 4 stages	4 perspectives	4 reflections on knowing	7 stages within 3 levels of thinking
Outline of stages or positions	1. Dualism 2. Multiplicity 3. Relativism 4. Commitment within relativism	1. Silence 2. Received knowledge 3. Procedural knowledge 4. Constructed knowledge	1. Absolute knowing 2. Transitional knowing 3. Independent knowing 4. Contextual knowing	1. Pre-reflective thinking 2. Quasi-reflective thinking 3. Reflective thinking

The first and most authoritative study on personal epistemology was by William Perry (1970). This informed the theoretical foundation for the other three major studies in this area by Belenky et al. (1986), Baxter Magolda (1992), and King and Kitchener (1994). Collectively they represent the major body of work in the development aspects of epistemology. Perry was criticised for using only males from an elite college (Harvard University). Belenky responded by using only females to examine whether Perry's findings could be applied to women's ways of knowing. Baxter Magolda followed by building upon the work of Perry and Belenky by using an evenly matched gender sample in her study, as did King and Kitchener. These four models, which are based on epistemological development in the undergraduate years, are of the most relevance to investigating undergraduate medical students. They focus in particular on understanding the meaning of epistemological development through the use of in-depth interviewing. Studies that used different methodologies in different educational settings which contributed to research on the nature of epistemologies are outlined in Table 3.

Table 3 Studies on the Nature of Epistemologies

Researchers	Research Instrument	Participants
*Perry (1970)	Interviews	Undergraduates across disciplines
*Belenky, Clinchy, Goldberger & Tarule (1986) *	Interviews	Undergraduates across disciplines
* Baxter Magolda (1992, 1994, 1996, 2002)	Interviews	Undergraduates and postgraduates across disciplines.
* King & Kitchener (1994, 2002)*	Interviews	Undergraduates and postgraduates across disciplines
*Schommer (1990, 1994, 2002)	Likert-questionnaire	Undergraduates across disciplines
Boyes & Chandler (1991)	Interviews	Adolescent school-children
Jehng, Johnson & Anderson (1993)	Likert-questionnaire	School-aged children
Kuhn (2000, 2001)	Interviews	Teens, 20's, 30's & 40's of college and non-college representation
Hofer (2004)	Interviews and observations	Undergraduate students in chemistry course
Lyons (1990)	Case study	High school teachers
Phillips (1998, 2001)	Likert-questionnaire	Undergraduate accounting students
De Corte, Eynde & Verschaffel (2002); Eynde, De Corte & Verschaffel (2006)	Likert-questionnaire	School-age mathematics students

The studies marked with an asterisk are reviewed in-depth in this chapter, as they are associated with undergraduate education. Schommer's (1990) quantitative study was also reviewed as this is the major study proposing that epistemologies are a set of independent beliefs, not a development model. The development model studies were significant and the scale of these has not been replicated. For example, Perry's (1970) was a 10-year longitudinal study, and King and Kitchener (1994) have interviewed students over a period of 15 years. As stated by Braten (2010), "most educational research on personal epistemology has been rooted in Perry's (1970) longitudinal interviews" (p. 211) and, therefore, is foremost in this review of the literature.

Perry's Scheme of Intellectual and Ethical Development

William J. Perry's book titled *Forms of Intellectual and Ethical Development in the College Years: A Scheme* (1970) was informed by two consecutive studies. His development model is known in the literature as the Perry Scheme. Professor Perry was Head of Harvard's Bureau of Study Counsel in the 1950's and approximately 15% of the students at Harvard sought counsel from his Bureau in times of distress. Perry noted the variety in how students "first experienced their

pluralistic environment followed by an equally wide variety in the ways in which students went on to assimilate that experience" or "found the notion of multiple frames of reference almost unintelligible" (Perry, 1970, p. 4). Perry and his staff subsequently undertook to document the experience of undergraduates at Harvard over their four-year period of college, beginning in 1953. Initially, Perry thought the differences in students' responses to the impact of intellectual and moral relativism were a result of differences in personality. Associating difference in personality to intellect was recognised as current thinking in the 1960's (Perry, 1970).

Perry devised a measure called *A Checklist of Educational Views* (CLEV), which is a one-dimensional approach that focuses upon the student's preference for black-white or right-wrong, thinking in an authority-orientated outlook versus preference for contingent, relativistic thinking in an outlook of greater individual judgment. Perry administered the CLEV to a random sample of 313 freshmen (1st year college) in the fall of 1954 and spring of 1955 (6 months later), and then invited 55 students for interviews based on their scores. The interview participants included those with extreme scores on the CLEV, students from the mean of the group, and some who had changed their scores markedly in the 6 months. Thirty one students agreed to be interviewed annually for the 4 years of their college education. The result was a total of 98 interviews which included complete four-year records for 17 students. The interviews were conducted in an open-ended manner to capture what was salient in the student's own experience. Students were first asked, "Would you like to say what has stood out for you during the year?" After the student's general statement, they were asked: "As you speak of that, do any particular instances come to mind?" (Perry, 1970, p. 7).

The reading of the transcripts led Perry to conclude that tendencies towards dualistic thinking vs. contingent thinking appeared less as the personal styles he had originally conceived, but were more characteristic of stages in a developmental process. Perry proceeded to outline his scheme of intellectual and ethical development based on these interviews. In addition, he attempted to "explicate those transitional steps which articulate the development from stage to stage" (Perry, 1970, p. 9).

This led Perry to embark on a second larger study to validate the scheme. This time, the students selected were not based on CLEV scores but were a randomly selected sample of 109 first-year students (85 male, 24 female) from the entering classes of 1958 and 1959, who were interviewed annually for 4 years, resulting in a total of 366 interviews, including 67 complete four-year records by 1963. Based on the analysis, Perry described a scheme which consists of nine positions of development (see Table 4 - Perry's Scheme of Intellectual and Ethical Development). These positions are further clustered into four sequential categories: dualism, multiplicity, relativism, and commitment within relativism.

Table 4 Perry's Scheme of Intellectual and Ethical Development

DUALISM (positions 1 and 2)
Position 1: Basic Duality: Student sees the world in polar terms of we-right-good vs. other-wrong-bad. Right answers for everything exists in the absolute, known to Authority whose role is to teach them.
Position 2: Multiplicity Pre-legitimate: Student perceives diversity of opinion and uncertainty, and accounts for them as unwarranted confusion in poorly qualified Authorities or as mere excuses set by Authority so "we can learn to find The Answers for ourselves".
MULTIPLICITY (positions 3 and 4)
Position 3: Multiplicity: Student accepts diversity and uncertainty as legitimate but still temporary in areas where Authority "hasn't found The Answers yet". He supposes Authority grades him in these areas on "good expression" but remains puzzled as to standards.
Position 4 (a): Multiplicity Legitimate but Subordinate: Students perceives legitimate uncertainty (and, therefore, diversity of opinion) to be extensive and raises it to the status of an unstructured epistemological realm of its own in which "anyone has a right to his own opinion," a realm which he sets over Authority's realm where right-wrong still prevails, or
Position 4 (b): Relativism Subordinate: Student discovers qualitative contextual relativistic reasoning as a special case of "what they want" within Authority's realm.
RELATIVISM (positions 5 and 6)
Position 5: Relativism: Student perceives all knowledge and values (including authorities) as contextual and relativistic and subordinates dualistic right-wrong functions to the status of a special case in context.
Position 6: Commitment Foreseen: The student apprehends the necessity of orienting himself in a relativistic world through some form of personal commitment (as distinct from unquestioned or unconsidered commitment to simple belief in certainty).
COMMITMENT (positions 7, 8 and 9)
Position 7: Initial Commitment: The student makes an initial Commitment in some area.
Position 8: Orientation in Implications of Commitment: Student experiences the implications of commitment, and explores the subjective and stylistic issues of responsibility.
Position 9: Developing Commitment: Student experiences the affirmation of identity among multiple responsibilities and realises commitment as an ongoing, unfolding activity through which he expresses his lifestyle.

Perry (1970), as reported in King (2009), summarised the scheme as follows:

> In its full range the scheme begins with those simplistic forms in which a person construes his world in unqualified polar terms of absolute right-wrong, good-bad; it ends with those complex forms through which he undertakes to affirm his own commitments in a world of contingent knowledge and relative values. The intervening forms and transitions in the scheme outline the major steps through which the person, as evidenced in our students' reports, appears to extend his power to make meaning in successive confrontations with diversity. (King, 2009, p. 603)

The crucial turning point in this scheme is when the students make the change from a dualistic view to contextual relativism (Position 5 of relativism). Perry (1981) referred to it as "a drastic revolution" (p. 109) and was characterised by a shift in the self as maker of meaning. Student placement in positions 7-9 was very rare during the research (Perry, 1981) and was only achieved by final fourth-year college students.

Perry's scheme describes the qualitative reorganisation of how students made meaning of their college experience and ways of knowing through the stages of dualism, multiplicity, relativism, and commitment and has been utilised to assess students' development (Grove, 2010; Marra & Palmer, 2004; Marra, Palmer & Litzinger, 2000; Moore, 1989; Pavelich & Moore, 1996). However, not all students develop through these stages in their educational institutions. Subsequently, Widdick and Simpson (1978) adapted Perry's Model into a set of behaviour descriptions to explain the characteristics of students in each stage as they relate to their learning environment and recommended that teachers adopt appropriate styles of teaching. For example, in relation to students in the dualism stage, some of the key characteristics are:

> Encounters with uncertainty or diversity are often very stressful….an "open" classroom would not be a happy place for these students….Interpretative tasks (e.g., essays) pose great difficulties…the student does not recognise that a variety of legitimate viewpoints exists…Evaluation may take on an overwhelming importance. (Wildick & Simpson, 1978, p. 31)

In contrast, characteristics of students at the relativism stage:

> Manage their studies more efficiently and effectively...are capable of performing complex analytical tasks….Learning has become more internalized and they seem more able to use "freedom to learn"…they express less concern about pleasing the teacher and the evaluation procedures. (Wildick & Simpson, 1978, p. 32)

Subsequent research using Perry's scheme includes a longitudinal study of 27 students in a four-year engineering degree (Wise, Lee, Litzinger, Marr & Palmer, 2004). The study reported there was little change in the first three years of the program and a change equivalent to one position from third to fourth year. In their final year, 10 of the students demonstrated development with "Perry scale ratings of 5-7. Nine students had a Perry rating below 4; this was the lowest rating represented in the sample" (Marra & Palmer, 2004, p. 111).

A subsequent study (Marra & Palmer, 2004) purposefully selected 19 of these 27 students for further investigation as these represented the highest and lowest positions on the Perry Scheme. The authors reported that ten students in the original sample demonstrated "Perry scale ratings of 5-7. Nine students had a Perry rating below 4; this was the lowest rating represented in the sample" (Marra & Palmer, 2004, p. 111). A cross-case analysis of interviews for recurring themes and analysis showed "four recurring themes for both sets of students: teaching and learning,

problem-solving process, group work, and the whole college experience" (p. 114). These results were presented as Students Qualitative Profiles and included thick description of their experience. Based on these qualitative profiles, Marra and Palmer (2004) argued ten senior-year students who "achieved Perry position five and beyond representing contextual relativism, embody the characteristics we desire in graduates with a bachelor's degree" (p. 121). In comparison, students who held the lowest positions in the Perry Scheme were students who continued to see "problem solving activities in terms of procedure previously defined by an authority figure than a creative process" (p. 121). The authors cited their study "provided evidence for means of adjusting curricular experiences so they will be more effective for students of varying levels of intellectual development which also enabling intellectual growth" (p. 121).

More recently, the framework of Perry's Scheme was used to investigate students who struggled with learning organic chemistry in a spiral curriculum. This spiral curriculum was described as teaching organic chemistry in the first semester "as a broad survey. During the second semester, students revisit material…albeit in greater detail, and with a focus on more advanced mechanisms, modern reactions and synthetic strategies" (Grove & Bretz, 2010, p. 207). They explained that this research provides a "more holistic description of the challenges that students encountered in learning chemistry in the context of a newly implemented spiral curriculum" (p. 208). One of the challenges of the nature of organic chemistry and the substitution/elimination reactions is that it "frequently requires students to find several answers to the same problem or devise multiple pathways" (p. 210). A phenomenographic framework was used and 18 students were purposefully selected according to diversity in gender, academic level, and academic performance in general chemistry. There were 8 high-performing, 5 average, and 5 low-performing students. There were 11 students from second year, 3 students in third and fourth years, and 1 student from first year. Students were paid a nominal sum to complete three reflective essays and participated in an interview which "utilized a semi-structured format and focused on exploring topics from the reflective essays in more detail" (Grove & Bretz, 2010, p. 209). The authors reported seven broad themes which emerged from the data. The most significant theme, named 'straightforwardness of organic chemistry', was outlined in the report and illustrated by thick description from three students in the study. The other themes were not named. The findings reported "students who function as dualistic thinkers struggle with the complexity of the subject matter. Understanding the substitution/elimination reactions and multi-step synthesis is consistent with subsequent epistemological development to Perry's multiplistic and relativistic stages" (p. 207).

In view of Perry's study, which used traditional university age students in an elite university, Cleave Hogg (1996) decided to interview mature-aged students who had returned to study at the

University of Toronto. The age sample was between 30-64 years and the analysis was based upon Perry's scheme. Returning to study for these students was a major commitment. The results showed that these students "approached learning from a position of contextual relativism…they accepted responsibility for their learning…they also acknowledge the implication of commitment to knowledge and realised that this was an ongoing, unfolding activity" (Cleave-Hogg, 1996, p. 245).

Perry's (1970) study only included two women in the results and did not account for the exclusion of the other 22 women, but claimed that this development scheme could be applied for females. Perry was the first researcher to describe how students made meaning of their college experience and that this was not a reflection of their personality, but an ongoing developmental process in response to the college environment.

Women's Ways of Knowing

Belenky et al. (1986) were interested in researching women's experience with knowing and learning, and their book entitled *Women's Ways of Knowing: The Development of Self, Voice and Mind* is the result of in-depth interviews with female subjects only. The decision to include only women was in direct response to the previous work by Perry (1970), which excluded women from the theoretical analysis and was criticised for generalising from an elite male sample to the general population of college students (King, 2009). Belenky et al. also drew on the influence from the work of Carol Gilligan (1982) on women's moral development which, in turn, was in response to criticism of Kohlberg (1969):

> Kohlberg's model of moral development is based on the male perspective only which is preoccupied with individual rights and blind, objective justice. Women, on the other hand, are more concerned with responsibility, caring and relationships. (Schommer, 1994, p. 297)

Therefore, the research conducted by Belenky et al. was in response to this gender imbalance. Mary Belenky recalled in an interview that, when she was a graduate student in psychology, she was told to use male subjects because women mess up the data. In this same interview, Mary Belenky reflected on both the praise and the criticism which was directed at their book for its focus on women and pointed out that the insights were not limited to women only: "We are not claiming that these might not also be men's ways of thinking. Women's ways, she asserts, are ultimately human ways" (Ashton-Jones & Thomas, 1990, p. 276).

The researchers conducted in-depth interviews often lasting between 2-5 hours and their focus was "to explore with the women their experience and problems as learners and knowers" (Belenky et al., 1986, p. 11). Interviews were undertaken with 135 women, 90 of whom were enrolled in university courses and 45 in the human services field. These 45 participants were

accessing services for parents in the human services agencies and were the most socially, economically, and educationally disadvantaged of the study. The other 90 participants were women chosen from six diverse colleges, including prestigious and rural colleges. The selection of university participants was based on consultation with the faculty administration, who were invited to provide names of "students who were likely to be representative informants of academic performance, and degree of alienation or engagement from the college" (Belenky et al., 1986, p. 12). The participants were firstly asked the same question that Perry (1970) began with: "What stands out for you in your life over the last few years?" and extended this to a question on "What stays with you?". Further questions were informed by previous studies in gender and moral development (Gilligan, 1982; Kohlberg, 1969).

The analysis took a phenomenological approach to what the women thought about knowledge, authority, truth, and themselves. The analysis began using Perry's scheme, but reported: "women's thinking did not fit so neatly into his categories" (Belenky et al., 1986, p. 14). In addition, the data did not fit with Perry's sequential ordering of positions. The model they proposed was built upon Perry's Scheme but, instead of 'positions', they described "'epistemological perspectives' from which women know and view the world" (p. 15). They reported that they drew on the retrospective accounts of women's experiences from the interviews and, therefore, were unable to say whether the epistemological perspectives could be presented as stages. However, they were able to report on a growth metaphor which emerged to form a major category in the development of their model. This was the metaphor of voice. This was evident when women in the study talked about their intellectual development: "again and again women spoke of 'gaining a voice" (p. 16). The first epistemological perspective in their model is Silence, which the authors explain was chosen because "the absence of voice in these women is so salient" (p. 24). The researchers stated it was rare in the interviews, but included this perspective because it represented "an extreme in denial of self and in dependence on external authority for direction" (p. 24).

Women's perspectives on knowing were placed into five epistemological categories: 1) Silence, 2) Received Knowledge, 3) Subjective Knowledge, 4) Procedural Knowledge, and 5) Constructed Knowledge. The premise was that these were not fixed, exhaustive or universal categories; that similar categories may be found in men's thinking; and that other people may organise their observations differently (Belenky et al., 1986, p. 15). These five epistemological perspectives are presented beginning with a summary and are followed by explanation and examples.

Silence

In this perspective, women experience themselves as mindless and voiceless and subject to the whims of external authority. Women in the position of silence were few and were from the 45

participants interviewed from the human services agencies. Women in this category were described as having no sense of self, experiencing disconnection, see authority as all-powerful, and are passive and voiceless: "even though each of the women had the gifts of intelligence and of all their senses, they were unaware of the potential of such gifts" (p. 12). For this group of women, "words were perceived as weapons. Words were used to separate and diminish people, not to connect and empower them. The silent women worried they would be punished for using words – any words" (p. 24). It was common for these women to have experienced the use of violence as a behavior in their upbringing, rather than the use of words. One salient example of this was from a woman who described: "My father was a first class bastard. The only way he believed of doing anything was with a club, stick, or with the back of his hand. All you had to do was breathe" (Belenky et al., 1986, p. 32).

Received Knowledge

Women conceived of themselves as capable of receiving, even reproducing, knowledge from the all-knowing external authorities, but not capable of creating knowledge on their own. Women in this perspective "think of words as central to knowing", as distinct from the silent women "who think of themselves as 'deaf and dumb' and are unaware of the power of words for transmitting knowledge" (Belenky et al., 1986, p. 36). The women described *listening* as a way of knowing. They listened to authorities and to other students in college. Unlike the women in the position of silence, women in the position of received knowledge reproduced this knowledge they have listened to. However, they believed that this knowledge still comes from others in authority and not from within their selves. Clinchy (2002) explains that these women "believe that for every question there is a single correct answer. They see the world in terms of black and white, right or wrong, true and false, good and bad; there is no room for ambiguity" (p. 66). An example of this notion of black and white, or right and wrong, is:

> When I read things I get very frustrated. I can read one thing and it seems to make sense. Then I read something else and that makes sense, and it would be conflicting views. I don't trust what I believe – how can I trust what I read – or how to know what's valid! (Belenky et al., 1986, p. 51)

Subjective Knowledge

This is a perspective from which truth and knowledge are conceived of as personal, private and, subjectively, known or intuited. The changes that occur in this position are "from passivity to action, from self as static to self as becoming, from silence to protesting inner voice and infallible gut" (Belenky et al., 1986, p.54). Almost half of the 135 women were in this category. Women in this position described how the source of knowledge shifts from an external authority as they first become aware of their inner resources for knowing. They discover their inner expert for the first

time, as one woman described: “I can only know with my gut...my gut is my best friend” (p. 53). While another emphasised a newly recognised power in her inner voice: “there’s a part of me that I didn’t even realise I had until recently – instinct, intuition, whatever...I just listen to the inside of me and I know what to do” (p. 69). Women see knowledge as very intuitive, private and personal and do not impose their views or knowledge on others: “I don’t try to suffocate people with my ideas or anything like that. I only know for myself. That is a truth for me. I believe in myself and my powers” (p. 70).

Procedural Knowledge

Women in this perspective are investing in learning and applying objective procedures for obtaining and communicating knowledge. Procedural knowing can take two forms, depending on how knowledge is acquired. These were defined as epistemological orientations. Belenky et al. (1986) proposed two contrasting orientations: “a separate epistemology, based upon impersonal procedures for establishing truth, and a connected epistemology, in which truth emerges through care” (p. 102).

In the form of separate knowing, the women primarily came from the traditional, elite, mainly female colleges and were accustomed to conforming to academic standards. They doubted ideas that are intuitive or feel right. The pattern of separate knowing is detached and impersonal and ideas were critically examined. This was explained as “separate knowing…is the opposite of subjectivism. While subjectivists assume that everyone is right, separate knowers assume that everyone—including themselves—may be wrong” (p.104).

In the form of connected knowing, the women developed procedures for gaining access to other people’s knowledge and to learning from their perspective. This was described as a capacity for empathy in which personal connection and understanding is emphasised. Belenky et al. (1986) illustrated the differences between a separate knower and a connected knower by the task of a poetry assignment. The separate knower asked of herself: “What standards are being used to evaluate my analysis of this poem? What techniques can I use to analyse it?” (p. 101). The connected knower asked of herself: “What is this poet trying to say to me?” (p. 101). In the case of a separate knower, the task is driven by the methods of the academic discipline, whereas the orientation of the connected knower is driven towards understanding the perspective of another.

Constructed Knowledge

This is a perspective in which “women view all knowledge as contextual, experience themselves as creators of knowledge and value both subjective and objective strategies for knowing” (Belenky et al., 1986, p. 15). Constructed knowledge represents an integration of subjective and objective strategies for knowing: "All knowledge is constructed and the knower is an intimate part

of the known" (p. 137). The individual sees herself in the construction of knowledge and as one whose own frame of reference matters. In addition, these frames of reference can be constructed and reconstructed by the knower once the interconnection of knowledge is realised.

Belenky describes the difference between procedural and constructed knowers as “procedural knowers remain subservient to disciplines and systems, constructivists move beyond system” (p. 140). Constructivist knowers learn to make connections to integrate topics of knowledge and, furthermore, “there is a new excitement about learning and the power of the mind” (p. 140). The following quote from Belenky’s work illustrates this perspective:

> I am starting to care about academics. I’m beginning to feel that my courses have been connected. It’s much more interesting once one discipline starts to interconnect with others. You go through your own courses, pull together your own connections, figure out connections yourself. (Belenky, 1986, p. 140)

The strength of Women’s Ways of Knowing was that it contributed a greater diversity to the Perry Model by using students from a range of backgrounds and colleges and institutions. In addition, the researchers showed that women’s self-concepts and ways of knowing are intertwined. (Belenky et al., 1986, p. 3).

In a subsequent interview study, Hipp (1997) investigated the conceptions of learning with 16 females who were engaged in postgraduate distance education. Results showed the students’ conceptions of themselves as learners were congruent with women’s ways of knowing.

Epistemological Reflection Model

Baxter Magolda (2004) initially tried to devise a quantifiable paper-pencil measure of the positions in Perry’s Scheme and her dissertation was on the initial validation of a survey instrument called the Measure of Epistemological Reflection (MER). Baxter Magolda reported that the MER was “a short-essay production task that posed questions about the role of the instructor, learner, peers, and evaluation in learning, and the nature of knowledge and educational decision-making” (Baxter Magolda, 2004, p. 32). However, some of the results from this study were congruent with Perry’s Scheme. Concurrently, Baxter Magolda was absorbing the results of *Women’s Ways of Knowing* (Belenky et al., 1986) and noted the similarities between the Perry Scheme and Women’s Ways of Knowing. She noted “the most complex phase of both portraits was similar in focus on constructing knowledge from relevant evidence in a context” (Baxter Magolda, 2004, p. 33). The focus in Baxter Magolda’s study was more on gender-related differences in college students and her stance shifted from a quantitative perspective to a qualitative narrative approach. This resulted in a 5-year longitudinal study to explore “how gender shaped college student’s approach to the nature, limits, and certainty of knowledge” (Baxter Magolda, 2004, p.

33). The longitudinal study commenced in 1986 with 101 first-year college students (51 women, 50 men) from Miami University in Ohio taking part in an annual interview of between 60 to 90 minutes. The participants were randomly selected, represented all six divisions of the university from arts to sciences, and were gender-balanced to ensure the legitimacy of results in relation to gender and development. Admission to the college was competitive and of note is that 70% of the participants were ranked in the top 20% of their high school class.

The interviews began in a similar fashion to Perry's, by asking students to describe their most significant educational experience of the year. As reported in Hofer and Pintrich (1997), the interview was designed to address the six areas of epistemological development: the role of the learner, instructor, peer, and evaluation in knowledge, the nature of knowledge, and decision-making. Students were asked to talk freely about these six areas in their annual interviews.

The coding structure for the interviews was initially based on a combination of the first five positions from Perry (1970) and the five perspectives of Belenky et al. (1986). Over the 5-year period of the study, the direction that the interviews took caused Baxter Magolda to call into question her theoretical assumptions about the nature of research and the nature of the developmental models. Firstly, she shifted to a more naturalistic interpretation of the data and, secondly, she viewed "existing developmental models as descriptions of how contexts have shaped young adults rather than as descriptions of what is possible in terms of developmental growth" (Baxter Magolda, 2004, p. 39). In 1992, Baxter Magolda published the epistemological reflection model based on the results that emerged from 80 sets of 4-year interviews. The model consists of four epistemological levels or ways of knowing: (1) Absolute Knowing, (2) Transitional Knowing, (3) Independent Knowing, and (4) Contextual Knowing. Each of these is defined by a set of qualitative assumptions about the qualities of 'knowing'.

Furthermore, Baxter Magolda found that there was a difference in the pattern of how males and females used these four ways of knowing, which she categorised as: (1) receiving or mastering knowledge, (2) interpersonal and impersonal patterns, and (3) inter-individual and individual patterns. These patterns are discussed in the context of Baxter Magolda's four epistemological levels or ways of knowing (absolute knowing, transitional knowing, independent knowing, and contextual knowing).

In addition, Baxter Magolda (1992) reported that each of these four ways of knowing were associated with "expectations of the learners, peers, and instructor in learning settings as well as to an understanding of how learning should be evaluated" (p. 29). These expectations and ways of knowing are outlined in Table 5.

Table 5 Epistemological Reflection Model

Domains	Absolute Knowing	Transitional Knowing	Independent Knowing	Contextual Knowing
Role of Learner	Obtains knowledge from instructor	Understands knowledge	Thinks for self Shares views with others Creates own perspective	Exchanges and compares perspectives Integrates and applies knowledge
Role of Peers	Share materials Explain what they have learned to each other	Provide active exchanges	Share views Serve as a source of knowledge	Enhance learning via quality contributions
Role of Instructor	Communicates knowledge appropriately Ensures that students understand knowledge	Uses methods aimed at understanding Employs methods that help apply knowledge	Promotes independent thinking Promotes exchange of opinions	Promotes application of knowledge in context Promotes evaluative discussion of perspectives
Evaluation	Provides vehicle to show instructor what was learned	Measures student's understanding of the material	Rewards independent thinking	Accurately measures competence Student and teacher work towards goal and measure progress
Nature of knowledge	Is certain or absolute	Is partially certain and partially uncertain	Is uncertain - everyone has own beliefs	Is contextual: judge on basis of evidence in context

Absolute Knowing: Receiving or Mastering Knowledge

The core assumption at this level is that knowledge is absolute and certain. At this level, females more commonly use a 'receiving' pattern and males a 'mastery' pattern. The receiving pattern is characterised by learning through listening and recording information. The mastery pattern is characterised by participating in activities and peer engagement. Baxter Magolda (1992) describes "mastery of the material takes precedence over comfort in the learning environment for them [males]" (p. 270)

Transitional Knowing: Interpersonal and Impersonal Patterns

At this level, the assumption is that knowledge is partially certain and partially uncertain. The two patterns within this group are interpersonal learning and impersonal learning. Females were more likely to use interpersonal learning, which is described as "listening to peers and relating their

ideas to personal experience. They expected rapport with the instructor and... tended to focus on the uncertain portion of knowledge suggesting that personal judgment would resolve uncertainty" (Baxter Magolda, 1992, p. 271). Males used the pattern of the impersonal approach more often and it is described as stressing "understanding rather than memorising material, being forced to think and exchanging ideas through debate" (p. 271). In addition, males "expected challenge from instructors" and "demonstrated an equal focus on certainty and uncertainty and used logic and research to resolve uncertainty" (p. 271).

Independent Knowing: Inter-individual and Individual Patterns

The core assumption is that knowledge is uncertain. Students hold a variety of beliefs and see learning as "thinking for oneself and sharing viewpoints with others" (Baxter Magolda, 1992, p. 271). In this category of knowers, the issue of gender differences was not as significant as in the other two, but there were marked differences in relation to the role of peers and the nature of knowledge. For example, "for some students, mostly men, the source of knowledge shifted from authority to self" (p. 271) and they welcomed the opportunity to challenge the other students with their views. In contrast, "for other students, mostly women, the source of knowledge shifted from collecting others' ideas as one's own to thinking independently" (p. 271).

Contextual Knowing

Contextual knowers were only present in two students interviewed in their senior (4th) year of college. Contextual knowing "required connecting to others and the subject to be known, yet at the same time required standing back to analyse the situation" (Baxter Magolda, 2004, p. 38). This required students to identify criteria for themselves and to make decisions based on these criteria. Judgment on the basis of new evidence and new contexts was required. In the context of a new learning situation, their approach was to "seek out persons who have developed expertise in the learning situation, and combine their own and others' expertise in learning" (Baxter Magolda, 2004, p. 26).

Reflecting on the Epistemological Reflection Model, 12 years after its publication, Baxter Magolda highlighted the social constructivism of her model, which portrays:

> Personal epistemology as socially constructed and context-bound… people actively construct and make meaning of their experience….They interpret what happens to them, evaluate it using their current perspective, and draw conclusions… The meaning they construct depends on their current assumptions they encounter, and the context in which the experience occurs. (Baxter Magolda, 2004, p. 31)

This reflection was based on her studies, which by that time (her original study started in 1992) had extended to a 16-year longitudinal study of young adults aged 18 years, some of whom remained in the study and had reached the age of 34 years.

The authors of a study of 53 students in adult secondary education using open-ended interviews confirmed Baxter Magolda's epistemological reflection (Severiens & ten Dam, 1998). However, they reported that no student reached the level of contextual knowing. Initial studies by Brownlee (2003) of students in a one-year postgraduate teacher education program also reported categories of epistemological beliefs similar to those of Baxter Magolda.

The Reflective Judgment Model

King and Kitchener (1994) were interested in the development of college students' reflective thinking abilities. They placed emphasis on the construct of reflective judgment first proposed by Dewey (1933), who saw such judgment as the outcome of good thinking about problems that are uncertain of solution and "are initiated when an individual recognizes that there is controversy or doubt about a problem that cannot be answered by formal logic alone" (King & Kitchener, 2004, p. 6). King and Kitchener's research was focused on the processes of reasoning in ill-structured problems as opposed to well-structured problems. They defined well-structured as:

> Problems that can be solved with deductive logic and can be ascribed with a high degree of completed-ness and problem solvers can be fairly certain that if they use the appropriate method or algorithm, the solution will be recognized and verified as correct. (King & Kitchener, 1993, p. 27)

Ill-structured problems, on the other hand, "cannot be defined with a high degree of completed-ness and…a high degree of certainty" (King & Kitchener, 1994, p. 5). Subsequently, the focus of their research was on "the ability to construct reasonable solutions" (King & Kitchener, 1994, p. 28). Specifically, they were interested in investigating: (a) whether college students reason reflectively, and (b) does their reasoning improve with additional exposure to and involvement at higher education? The outcome of this research was the Reflective Judgment Model. This model was used as the basis for developing the Reflective Judgment Interview (RJI). The RJI could only be administered and scored by trained raters. Raters were instructed to assign three scores to each ill-structured problem "to reflect whatever characteristic of reasoning they observe in the interview; these typically range across two adjacent stages… the stage most frequently observed is the dominant stage, followed by the subdominant stage(s)" (King & Kitchener, 2004, p.12). The scoring was designed to "reflect whatever stage-characteristics are evident in the transcript and not to assume a priori that consistency (or inconsistency) will be observed. Assigned scores are weighted across dominant and subdominant stages, and an overall dilemma score is calculated" (King & Kitchener, 2004, p. 12). The seven stages of this model are described in Table 6.

Table 6 Summary of Reflective Judgment Stages

Pre-reflective Thinking	Quasi-reflective Thinking	Reflective Thinking
Stage 1 View of Knowledge: knowledge is assumed to exist absolutely and concretely. It can be obtained with certainty by direct observation. Concept of Justification: Beliefs need no justification since there is assumed to be an absolute correspondence between what is believed to be true and what is true. Stage 2 View of Knowledge: Knowledge is assumed to be absolutely certain or certain but not immediately available. It can be obtained directly though the senses (as in direct observation) or via authority figures. Concept of Justification: Beliefs are unexamined and unjustified or justified by their correspondence with the beliefs of an authority figure (such as a teacher or parent). Stage 3 View of Knowledge: Knowledge is assumed to be absolutely certain or temporarily uncertain. In areas of temporary uncertainty, only personal beliefs can be known until absolute knowledge is obtained. In areas of absolute certainty, knowledge is obtained from authorities. Concept of Justification: In areas in which certain answers exist, beliefs are justified by reference to authorities' view. In areas in which answers do not exist, beliefs are defended as personal opinion since the link between evidence and beliefs is unclear.	Stage 4 View of Knowledge: Knowledge is uncertain and knowledge claims are idiosyncratic to the individual since situational variables dictate that knowing always involves an element of ambiguity Concept of Justification: Beliefs are justified by giving reasons and using evidence, but the arguments and choice of evidence are idiosyncratic (for example, choosing evidence that fits an established belief). Stage 5 View of Knowledge: Knowledge is contextual and subjective since it is filtered through a person's perceptions and criteria for judgment. Only interpretations of evidence, events, or issues may be known. Concept of Justification: Beliefs are justified within a particular context by means of the rules of inquiry for that context and by context-specific interpretations of evidence. Specific beliefs are assumed to be context-specific or are balanced against other interpretations.	Stage 6 View of Knowledge: Knowledge is constructed into individual conclusions about illustrated problems on the basis of information from a variety of sources. Interpretations that are based on evaluations of evidence across contexts and on the evaluated opinions of reputable others can be known Concept of Justification: Beliefs are justified by comparing evidence and opinion from different perspectives on an issue or across different contests and by constructing solutions that are evaluated by criteria, such as the weight of the evidence, the utility of the solution, or the pragmatic need for action. Stage 7 View of Knowledge: Knowledge is the outcome of a process of reasonable inquiry in which solutions to ill-structured problems are constructed. The adequacy of those solutions is evaluated in terms of what is most reasonable or probable according to the current evidence, and it is reevaluated when relevant new evidence, perspectives, or tools of inquiry become available. Concept of Justification: Beliefs are justified probabilistically on the basis of a variety of interpretive considerations, such as the weight of the evidence, the explanatory value of the interpretations, the risk of erroneous conclusions, consequences of alternative judgments, and the interrelationships of these factors. Conclusions are defended as representing the most complete, plausible, or compelling understanding of an issue, not the basis of the available evidence.

Stages Within the Reflective Judgment Model

King and Kitchener (2002, 2004) summarised the 7-stage Reflective Judgment Model into three major periods: the pre-reflective (stages 1-3), the quasi-reflective (stages 4 and 5), and the reflective (stages 6 and 7) and present the epistemic assumptions of each period. An overview is presented here together with an excerpt from the original interviews in accompanying text boxes (the 'I' represents the interviewer and 'R' stands for respondent.)

Pre-Reflective Reasoning (Stages 1-3)

People who hold epistemic assumptions related to pre-reflective thinking believe knowledge is gained through the word of an authority figure or through firsthand observation. People who hold these assumptions treat all problems as though they were well-structured. An example of Pre-Reflective Thinking (Stage 2) is:

I: Can you ever know for sure that your position on this issue is correct?
R: Well some people believe that we evolved from apes and that's the way they want to believe. But I would never believe that way and nobody could talk me out of the way. I believe because I believe the way that it's told in the Bible.
I: In this case the, is one view right and one point of view wrong?
R: Well, I think the evolved one is wrong.

Quasi-Reflective Thinking (Stages 4-5)

People who reason using the assumptions of quasi-reflective thinking recognise that knowledge – or more accurately knowledge claims – contain elements of uncertainty which they attribute to missing information or to methods of obtaining the evidence. An example of Quasi-Reflective Thinking (Stage 4) is:

R: I'd be more inclined to believe it (evolution) if they had proof. It's just like the pyramids. I don't think we will ever know. People will come up with different interpretations because people differ. Who are you going to ask? Because no one was there.

Reflective Thinking (Stages 6-7)

People who reason using reflective thinking assumptions accept that knowledge claims cannot be made with certainty, but are not immobilised by it; rather, they make judgments that are most reasonable and about which they are reasonably certain, based on their evaluation of the available data. They believe they must actively construct their decisions, and that their knowledge claims must be evaluated in relationship to the context in which they were generated.

An example of Reflective Thinking (Stage 7) is:

> I: Can you every say you know for sure about this issue?
> R: It [the view that the Egyptians build the pyramids] is very far along the continuum of what is probable.
> I: Can you say that one point of view is right and one is wrong?
> R: Right and wrong are not comfortable categories to assign to this kind of item. It's more or less likely or reasonable, more or less in keeping with what the facts seem to be.

King and Kitchener, when reflecting back on the hundreds of responses they have received, reported they had made three major observations:

> (a) There are striking differences in people's underlying assumptions; (b) these differences in assumptions are related to the way people make and justify their own judgments about ill-structured problems; and (c) there is a developmental sequence in the patterns of responses and judgments about such problems. (King & Kitchener, 2004, p. 5)

Accordingly, their work is presented as a "theoretical framework for understanding and organizing these observations" (p. 5). In addition, they found the Reflective Judgment Interview scores increased by educational level. These results were based on the average interview scores of a total sample of 1,344 from high school to advanced PhD students. The mean score for first-year college students was 3.63 and 4.02 for fourth year. King and Kitchener (2004) argued that, "while the numerical difference is small, it represents an important development in reasoning" (p. 35) as it places students in the quasi-reflective thinking of Stage 4, where "uncertainty is acknowledged as a persistent condition of knowing" (p. 35).

Overview of the Shifts in the Development Models of Epistemology

Each of the developmental models reviewed describes different stages or perspectives from which students can progress from naïve to more sophisticated beliefs of the nature of knowledge and knowing. A summary of the models is shown in Table 7. In each of these, the authors describe a turning point, or 'shift', in which this may occur. These shifts will be described in brief for each model in turn.

Perry's Scheme of Intellectual and Ethical Development

Perry (1970) uses the terminology of a watershed to describe the major shift in his model when students made the shift from a dualistic (absolutist) view to contextual relativism, which was position 5 in his scheme. Perry also describes this as a "drastic revolution" (p. 109) characterised by a shift in the self when "the person, previously a holder of meaning, becomes a maker of meaning" (p. 87) and "experienced in themselves the origins of meaning, which they had previously expected to come to them from the outside" (p. 92)

Women's Ways of Knowing

This model was not presented as stages or positions, but the authors drew upon Perry's model to analyse the retrospective accounts of the women "to speculate about different developmental sequences or trajectories" (Belenky et al., 1986, p. 15). These were grouped into five epistemological categories showing different perspectives from which "women view reality and draw conclusions about truth, knowledge and authority" (Belenky et al., 1986, p. 3).

The third epistemological category, termed subjective knowledge, was also described as a revolutionary step by these authors:

> As a woman becomes more aware of the existence of inner resources for knowing and valuing, as she begins to listen to the 'still small voice' within her, she finds an inner source of strength. A major developmental transition follows that has repercussions in her relationships, self-concept and self-esteem. (Belenky et al., 1986, p. 54)

In addition, for women in this category, their subjective knowledge about truth was "the most personally liberating event of their lives" (p. 54).

Epistemological Reflection Model

In this model, the turning point is referred to as an evolution of knowing, when individuals undergo a fundamental shift in their perception of their role as a learner, the roles of their peers and instructors. This occurs when "transitional knowers shifted from acquiring to understanding knowledge, expected teachers to focus on understanding and application, preferred evaluation focused on understanding rather than memorization, and used peers to explore different interpretations" (Baxter Magolda, 2004, p. 34).

Reflective Judgment Model

The second of the three development stages in this model, named quasi-reflective thinking, outlines a shift by the *action* of the knower moving from a passive spectator to an active constructor of meaning. This shift comes from the realisation that "uncertainty is part of the knowing process, the ability to see knowledge as an abstraction, and the recognition that knowledge is constructed" (King & Kitchener, 2004, p. 6).This shift is described as a major advance "as it lays the foundations for the construction of beliefs that are internally derived, not simply accepted by others" (King & Kitchener, 2004, p. 6).

Table 7 Summary of Development Models of Epistemology

Forms of Intellectual and Ethical Development (Perry, 1970)
1. Acknowledges absolute knowledge handed down by authority. 2. Acknowledges differences in opinion that are the result of poorly qualified authority. 3. Acknowledges uncertainty as temporary. 4. Acknowledges relativistic knowledge as the exception to the rule. 5. Acknowledges absolute knowledge as the exception to the rule. 6. Apprehends the need for personal commitment in a relativistic world. 7. Initial commitment is made. 8. Exploring commitment. 9. Acknowledges commitment as an ongoing, complex and evolving process.
Women's Ways of Knowing (Belenky, Clinchy, Goldberger & Tarule, 1986)
1. Silence: Women perceive themselves as mindless and voiceless. All knowledge is held by authority. 2. Received Knowledge: Women assume they can receive and reproduce knowledge that has been handed to them from authority. They cannot generate knowledge themselves. 3. Subjective Knowledge: Knowledge is considered person, private, and intuitive. 4. Procedural Knowledge: Knowledge is obtained and communicated with objective procedures. 5. Constructed Knowledge: Knowledge is obtained with both objective and subjective processes.
Epistemological Reflection Model (Baxter Magolda, 1992)
1. Absolute knowers view knowledge as certain and believe authorities have all the answers. 2. Transitional knowers begin to question the uncertainty of knowledge. 3. Independent knowers question authority as the only source of knowledge.
Reflective Judgment Model (King & Kitchener, 1994)
1. Absolute knowing is handed down by authority. 2. Absolute knowledge exists, but is not necessarily immediately known. 3. Some knowledge is temporarily uncertain. 4. All knowledge is uncertain. Hence, there is no way to determine which claim is correct or better. 5. Knowledge is subjective. Claims are made through subjective interpretation. 6. Objective knowledge is not possible. The knower plays an active role in constructing claims. 7. Knowledge is an ongoing process of inquiry and must be perceived as approximations of reality.

Epistemologies as a Set of Beliefs

Schommer was the first researcher to question the stage approach for the developmental models of personal epistemology. Following a review of the previous research on personal epistemology, Schommer attempted to synthesise the work of Perry (1970) with Ryan (1984) on meta-comprehension. The inconsistency in results led Schommer (1990) to challenge the assumption that "personal epistemology is unidimensional and develops in fixed stages" and, instead, to argue that "beliefs about the nature of knowledge are far too complex to be captured in a single dimension" (p. 498). Schommer then embarked on a more quantitative research program and developed a survey instrument (the Epistemological Questionnaire) to assess several epistemological dimensions.

Schommer hypothesised there were five epistemological beliefs which were independent of each other. These beliefs were:

> Structure of knowledge: Simple Knowledge. Does knowledge consist of unrelated and isolated pieces or is knowledge made up of integrated concepts?
>
> Stability of knowledge: Certain Knowledge. Is knowledge certain and unchanging or is knowledge tentative and evolving?
>
> Source of knowledge: Omniscient Authority. Is knowledge received from authority or is knowledge derived from personal theory or observation and reason?
>
> Speed of knowledge: Quick Learning. Does learning occur quickly or not at all or is learning a gradual process of learning?
>
> Control of knowledge acquisition: Innate Ability. Is the ability to learn fixed at birth or can the ability to learn improve over a lifetime? (Schommer-Aikins, 2002, p. 105)

The first three hypothesised beliefs: structure, stability and source were based on Perry's (1970) research, which suggested that a majority of students begin college believing knowledge is certain, simple, and derived from authority. Schommer described that the fourth belief of Speed of Knowledge was adapted from Schoenfeld's (1983, 1985) studies of high school students' geometry, who believed:

> Only the gifted can derive theorems or be creative in mathematics… believe in quick, all-or-none learning… spend 10-12 minutes working on a problem. If they do not get it by then, they assume they will never get it. (Schommer, 1990, p. 498)

The fifth belief of Control of Knowledge acquisition was derived from Dweck and Leggett's (1988) research on beliefs about the nature of intelligence that found "some students have a predominant belief that intelligence is a fixed entity, whereas others believe it is incremental" (Schommer, 1990, p. 498).

Following a pilot study in 1998, the Epistemological Questionnaire was "modified with the same five hypothesised epistemological beliefs in mind stated from a naïve epistemological persuasion" (Schommer, 1990, p. 499). They were restated as:

> These beliefs, followed by the shorthand description in brackets are the following (a) knowledge is simple rather than complex (Simple Knowledge), (b) knowledge is handed down by authority rather than derived from reason (Omniscient Authority), (c) knowledge is certain rather than tentative (Certain Knowledge),(d) the ability to learn is innate rather than acquired (Innate or (Fixed) Ability) and (e) Learning is quick or not at all (Quick Learning). (Schommer, 1990, p. 499)

The Epistemological Questionnaire consisted of a 63-item paper and pencil instrument to test these five hypothesised beliefs. Schommer consulted with three educational psychologists and the 63 items were subsequently categorised into 12 subsets. Two or more subsets were used in order to assess each of the five hypothesised beliefs. Participants were asked to respond to statements, such as "scientists can ultimately get to the truth" and "successful students learn things quickly" (p. 105), on a Likert scale from 1 (strongly agree) to 5 (strongly disagree). Of these 63 items, there were 28 which Schommer describes as a negative valence and 35 as a positive valence. She cites the following statements as examples of each: "You never know what a book means unless you know the intent of the author" (negative valence) and "It's a waste of time to work on problems which have no possibility of coming out with a clear cut and unambiguous answer" (positive valence) (Schommer, 1992, p. 437). Table 8 shows the overall scheme of the Epistemological Questionnaire and sample items, including an example of questions from each subset.

The first study using the Epistemological Questionnaire was given to 263 college students enrolled in an introductory psychology or introductory physics class of a mid-western American university. Over 95% of the students were either freshmen or sophomores (1st and 2nd year university) and the gender was evenly balanced. Factor analytic techniques revealed that the 12 subsets of measures loaded onto four independent factors, and Schommer reported this as evidence for four of the five hypothesised beliefs. These were titled according to the most naïve viewpoint, which are Simple Knowledge, Certain Knowledge, Fixed Ability, and Quick Learning. There was no evidence to support Schommer's hypothesised dimension of Omniscient Authority.

Table 8 Structure of Schommer's Epistemological Questionnaire with Sample Items

Sample Item	Subset dimensions (12 subsets)	Items
Simple Knowledge		
Most words have one clear meaning	Seek single answers	11
When I study I look for specific facts	Avoid integration	8
Certain Knowledge		
I don't like movies that don't have an ending	Avoid ambiguity	5
Scientists can ultimately get to the truth	Knowledge is certain	6
Omniscient authority		
People who challenge authority are over-confident	Don't criticize authority	6
How much a person gets out of school depends on the quality of the teacher	Depend on authority	6
Innate ability		
Self-help books are not much help	Can't learn how to learn	5
The really smart students don't have to work hard to do well in school	Success is unrelated to hard work	4
An expert is someone who has a special gift in some area	Ability to learn is innate	4
Quick Learning		
Successful students learn things quickly	Learning is quick	5
Almost all the information you can learn from a textbook, you will get from the first reading	Learn first time	3
If a person tries too hard to understand a problem, they will most likely just end up being confused	Concentrated effort is a waste of time	2

A second study (Schommer, Crouse & Rhodes, 1992) replicated the four factor structure with participants enrolled in an introductory psychology class in a mid-western American university. There were 424 students (157 men and 267 women) and 70% of the students were in their first year. Factor analysis confirmed Schommer's factor structure. The researchers duly concluded that, even though they had replicated the results with a larger sample, "we do not see this questionnaire as a final product; rather, we see it as a beginning approach towards the assessment of epistemological beliefs" (p. 441). Schommer later clarified that, where originally she hypothesised the beliefs were expressed on a continuum, she now believes epistemological beliefs are "better characterised as frequency distributions" (Schommer, 1994, p. 300). Ten years later, reviewing her research results, Schommer proposed a reconceptualisation of this field by stating she now saw personal epistemology as:

> A system of more or less independent beliefs. By system I mean there are multiple dimensions that compose personal epistemology. By more or less independent I mean that these beliefs may or may not develop at synchronous rates. (Schommer-Aikins, 2004, p. 20)

Summary of Schommer's Contribution

Schommer made an important contribution into the paradigm of personal epistemology. Prior to this work, researchers had proposed that epistemological views were a result of complex assumptions that developed together. Schommer (1994) introduced the concept that the beliefs about the structure, stability, speed, and control could develop separately.

However, Schommer's reconceptualisation of epistemological beliefs, particularly in regard to the inclusion of the factors of Quick Learning and Innate Ability, was criticised by Hofer and Pintrich (1997). They argued these two factors relate to beliefs about the nature of intelligence and learning, and were "well outside the construct of epistemological beliefs" (p. 108), which Hofer and Pintrich proposed "be limited to individuals' beliefs about the nature of knowledge and the processes of knowing" (p. 117).

The Theoretical Constructs of Personal Epistemology

In their review of educational research *The Development of Epistemological Theories: Beliefs about Knowledge and Knowing and Their Relation to Learning,* Hofer and Pintrich (1997) made a number of significant recommendations following their appraisal of previous research on epistemological theories. They proposed:

> The content of the construct of epistemological beliefs be limited to individuals' belief about the nature of knowledge and the nature of knowing… we propose that individual's beliefs about knowledge and the process of knowing be considered personal theories. (Hofer & Pintrich, 1997, p. 117)

Following on from this recognition of beliefs as personal theories, they proposed there were two general areas: the nature of knowledge and the nature of knowing, which "represent the core structure of individuals' epistemological theories" (p. 119). Within these two core structures:

> There are two dimensions each, providing four dimensions of epistemological theories… Under nature of knowledge, we suggest there are two dimensions: certainty of knowledge and simplicity of knowledge. Within the nature of knowing we propose two other dimensions: source of knowledge and justification for knowing. (Hofer & Pintrich, 1997, p. 119)

The authors argued these dimensions were present in most of the models of epistemological theory reviewed and hypothesised "these four dimensions should be considered the core of an individual's theory" (p. 119). Although this argument was first proposed in 1997, it remains "currently the most authoritative view on the dimensionality of personal epistemology, and as such widely recognised by researchers in this field" (Braten, 2010, p. 212).

It is important to stress that the constructs proposed by Hofer and Pintrich resulted from a synthesis of components from existing models of personal epistemology. Their rationale for this was "to help clarify the research and thinking in this area" (p. 133). As outlined in Chapter 2, different terms, descriptions and constructs were used by previous researchers in personal epistemology. Hofer later reiterated "although there are distinctions among the models, there are points of convergence among them about what individuals believe knowledge is and how it is that they know" (Hofer, 2000, p. 380). Furthermore, Hofer stated:

> It seems increasingly clear that personal epistemological theories, as described throughout the existing literature, are made up of somewhat discrete, but perhaps inter-related dimensions…and these elements that comprise personal epistemological theories appear explicitly in some models and must be inferred in others. (p. 380).

While these elements vary across the models, inherent in each, is the development of beliefs along a continuum from naïve beliefs at the low end to sophisticated beliefs at the high end.

The Four Dimensions of Personal Epistemological Theories

The core dimensions of personal epistemological theories as hypothesised by Hofer and Pintrich (1997) are outlined in Table 9 with a description of each dimension.

Table 9 Dimensions of Epistemological Theories from Hofer and Pintrich

CORE DIMENSIONS OF EPISTEMOLOGICAL THEORIES				
	Nature of Knowledge		**Nature of Knowing**	
Researchers	Certainty of Knowledge	Simplicity of Knowledge	Source of Knowledge	Justification for Knowing
King and Kitchener	Certain, right or wrong ↔ uncertain, contextual	Simple ↔ complex	Reliance on authority ↔ knower as constructor of meaning	Knowledge requires no justification ↔ Knowledge is constructed and judgments are critically re-evaluated
Schommer	Absolute ↔ tentative and evolving	Isolated, unambiguous bits ↔ interrelated concepts	Handed down from authority ↔ derived from reason	
Baxter Magolda	Absolute ↔ contextual		Reliance on authority ↔ self	Received or mastery ↔ evidence judged in context
Perry	Absolute ↔ contextual		Outside the self ↔ self as maker of meaning	
Belenky et al.			Received ↔ constructed Outside the self ↔ self as maker of meaning	

Certainty of Knowledge

This dimension refers to the degree to which an individual views knowledge as being of a fixed nature through to a more fluid nature. At the lower levels, individuals view knowledge as fixed and absolute, black and white, right and wrong. This represents a naïve epistemological belief on the continuum of this dimension. At higher levels, individuals view knowledge as fluid and relative, tentative and evolving, and modified in exchange with others and the environment. This represents a sophisticated epistemological belief.

Simplicity of Knowledge

This dimension refers to the degree to which an individual views knowledge as an accumulation of facts, isolated, unambiguous pieces of knowledge through to viewing knowledge as highly inter-related concepts. At the lower levels, knowledge is seen as discrete and concrete knowable facts. This represents a naïve epistemological belief on the continuum of this dimension. At the higher level, knowledge is viewed as relative, contingent and contextual, and this represents a sophisticated epistemological belief.

Source of Knowledge

This dimension refers to how an individual views the locus of knowledge. At lower levels, an individual views knowledge as originating outside self and residing in external authority from which it may be transmitted. This represents a naïve epistemological belief. At higher levels, an individual views knowledge as constructed in interaction with the environment and others. This represents a sophisticated epistemological belief on the continuum of this dimension.

Justification of Knowledge

This dimension refers to how individuals evaluate knowledge claims including the use of evidence; the use they make of authority and expertise; and their evaluation of experts. At lower levels, individuals may justify beliefs from observation of others, or authority or on the basis of what feels right for them. Knowledge for these individuals requires no justification. This represents a naïve epistemological belief. At higher levels, individuals are able to evaluate evidence in context and substantiate, justify and critically evaluate this knowledge. This represents a sophisticated epistemological belief.

The four dimensions of personal epistemology, as hypothesised by Hofer and Pintrich (1997), are diagrammatically illustrated in Figure 1. This shows the range of beliefs from the naïve to sophisticated level and is labeled with a brief description of each dimension.

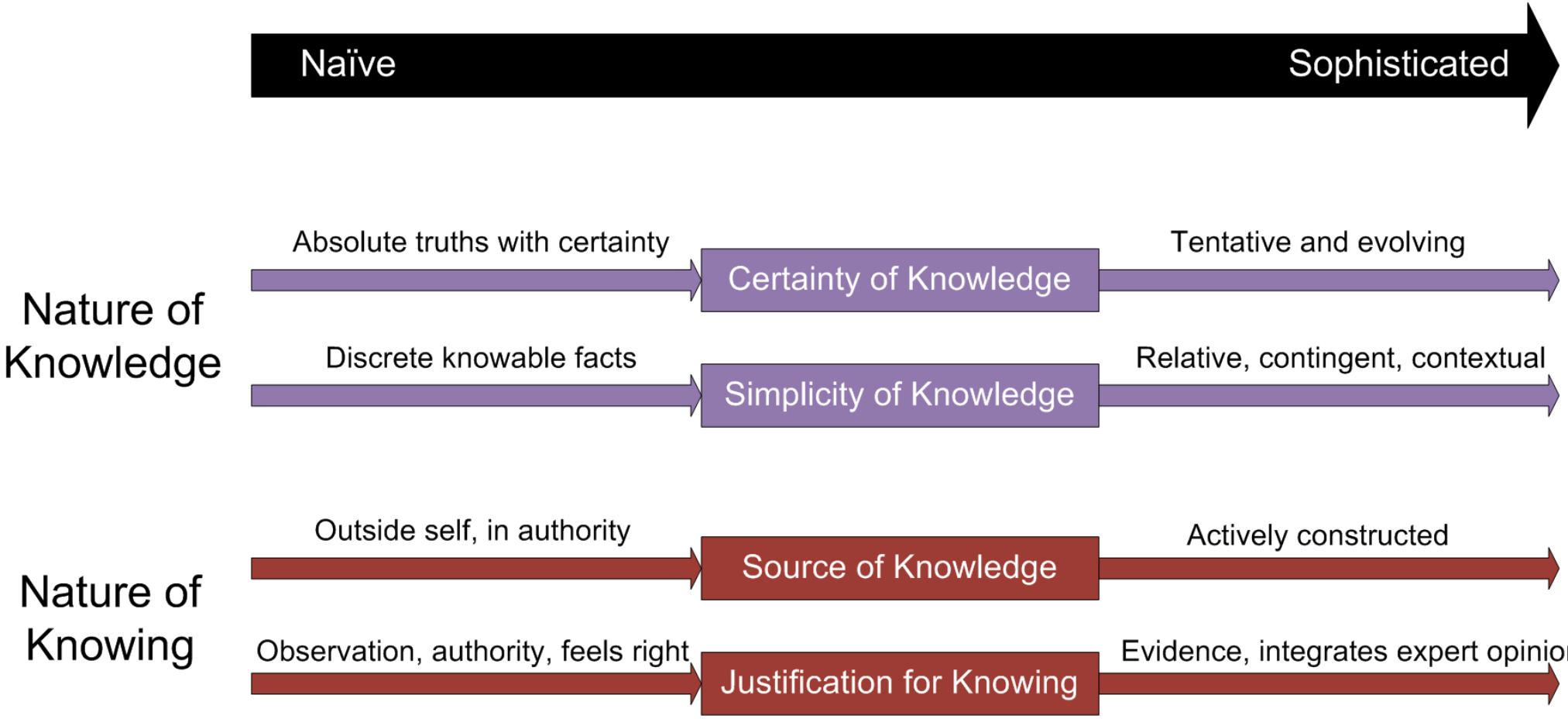

Figure 1 Dimensions of Personal Epistemological Beliefs from Hofer and Pintrich (1997)

Capturing the Dimensions of Personal Epistemology in Context

At the conclusion of their review of epistemological theories, Hofer and Pintrich made the following statements to guide future research in this field:

> Researchers' intent on better understanding epistemological development and its relation to learning may want to gather naturalistic evidence….
>
> We know little about the development progression of epistemological theories across education settings and what the epistemological issues might be in individuals making the transition from… high school to college or from college to work. In terms of development, these transitional periods may represent a time when development is more discontinuous and may provide a unique window on growth and change.
>
> Research at these transitional periods could provide an opportunity to examine individual cognitive-development factors as well as contextual opportunities and constraints that influence the development of personal epistemological theories. (Hofer & Pintrich, 1997, p. 132)

This supports the argument that, in this emerging field of research, the dimensions of personal epistemology are too complex to be captured by quantitative research methods alone. In addition, these investigations are best suited to understanding the development of personal epistemology in context in more naturalistic educational settings.

Hofer (2004) proceeded to undertake what she described as an exploratory study into these four hypothesised beliefs in context. Hofer conducted two interviews with 25 students enrolled in first-year introductory chemistry courses during their first and last weeks of first semester. The results stated there was evidence for each of the four dimensions of epistemological theories in this context. However, the interviews were based on semi-structured, pre-planned and standardised questions adapted from "existing interview protocols that tapped the range of the four dimensions suggested in the literature" (Hofer, 2004, p. 136). One such question adapted from Belenky et al. (1986) was: "In learning something you really want to know can you rely on experts?" (Hofer, 2004, p. 51). Hofer claimed this study was a "qualitative case study focused on the experience, perceptions, and meaning making" (p. 134) of these students. However, the study describes that the interview questions were pre-designed to tap into the four dimensions of personal epistemology and the analytic process comprised of examining the interviews for evidence of each of the dimensions. This suggests pre-existing research bias in the methodology and the process of analysis, given the stated intention of the study was to focus on the meaning making of students' experience with an Interpretivist research design paradigm.

Epistemological Beliefs in the Context of Medical Education

In 2007, Roex and Degryse argued for introducing the concept of epistemological beliefs into medical education. They highlighted the fact that "although much energy has been spent on revolutionary curriculum changes in medical school… insights into students' epistemological beliefs, have yet to find their way into the curriculum" (p. 617). These authors argued that students studying medicine are often faced with ill-structured problems for which there is often no right or wrong answer. Instead, the requirement is for "knowledge to be understood, integrated with existing knowledge, and applied to individual patients" (Roex & Degryse, 2007, p. 617).

In particular, Roex and Degryse (2007) cite the "complexity of the phenomenon of medical education and the vast array of theories" that contribute to this domain and suggest that the concept of epistemological beliefs "offers a framework for phrasing and studying issues that intuitively seem essential to educators such as the need for ill-structured questions in medical curricula and assessment" (p. 619). Furthermore, they argue that "training students to articulate their epistemological beliefs or by confronting students with reasoning processes based on more sophisticated levels of epistemological beliefs would enhance student's medical competence and performance" (p. 616). At the date of publication of Roex and Degryse's (2007) paper, there was one recent study published on epistemological beliefs in medical students (Knight & Mattick, 2006). There have been no other published studies on medical student's epistemological beliefs since 2007.

Studies on Epistemological Beliefs of Medical Students

Medical students' epistemological beliefs were investigated though an exploratory study (Knight & Mattick, 2006) of epistemological thinking of medical students in a 5-year problem-based, self-directed learning medical program with a "constructivist approach to learning with decreased contact and lecture time" (Knight & Mattick, 2006). In this program, students were confronted by "the challenge of ill-structured problems where information about a patients' case unfolds over two weeks…with no single clear-cut diagnosis at the end of the case…No precise boundaries are set on the amount of work expected" (p. 1088). Semi-structured interviews were conducted with 14 students at the end of their second year.

Through inductive analysis, one of the major themes was identified as epistemological thinking, which comprised five sub-themes: 1) Nature of knowledge: certainty, 2) Nature of knowledge: simplicity, 3) Nature of knowing: source of knowledge, 4) Nature of knowing: justification, and 5) Epistemological development. Knight and Mattick (2006) refer to the four core structural dimensions of personal epistemology (Hofer & Pintrich, 1997) and provide an overview of the Reflective Judgment Model from King and Kitchener (1994) in their article. Therefore, although

not explicitly stated in their methodology and analysis, the results and discussion are based on the Reflective Judgment Model. For example, under the heading of the Nature of knowledge: certainty, the following excerpt from one student was assessed as being at level 3 of the model, which is the pre-reflective stage: "I usually think everything is either black or white…I know medicine has a lot of grey areas but I think that's because we haven't found all the answers yet…so I think then it would be black and white" (p. 1089).

The authors concluded that:

> while most medical students interviewed reported epistemological transition since beginning their medical education, some participants entered the clinical context of their studies with relatively simplistic pre-reflective epistemological beliefs; knowledge was certain and justification for knowing based on opinion…some students, however, had more sophisticated beliefs upon entering the clinical years. They understood the need to evaluate evidence due to the ill-structured nature of the problems. (Knight & Mattick, 2006, p. 1094)

This study demonstrated limited interpretations of the dimensions of personal epistemological beliefs in the context of the PBL program. In the analysis, limited use was made of the Reflective Judgment Model to accompany some quotes and not referred to at all in others. The limitations of interviewing a small number of students at a single point in time was recognised and "thus it fails to capture the true dynamics of the situation, including the process of transition, epistemological thinking unfolding and enfolding across time and context" (p. 1095). They recommended investigating "how medical students make sense of every day events…to better capture the dynamic complexities within their epistemological thinking" (Knight & Mattick, 2006, p. 1095).

Implications for this Study in Medical Education

This literature review has that identified studies in a naturalistic setting are necessary to further understanding of personal epistemology, how it develops in educational settings, and the issues and contextual factors associated with epistemological development in the transition from school to university. In particular, the lack of studies which address these aspects in the context of undergraduate medical education provides further evidence and support for this study. Therefore, the purpose of this study was to investigate the personal epistemological development of undergraduate medical students as they transition from high school into an integrated problem-based medical curriculum. The study addressed five questions:

1. What were the patterns of epistemological beliefs between the highest and lowest ranked students in this study?
2. How did students' epistemological beliefs evolve over the first two years?

3. What epistemological components in the educational environment that students experienced, made sense of, and were the most salient?
4. How were these epistemological components interpreted by the students within the four dimensions of personal epistemological beliefs?
5. How did the epistemological beliefs held by students relate to the process of problem-based-learning?

The study design used to investigate these research questions is discussed in Chapter 3.

Chapter Summary

This chapter took a theoretical approach and focused on a comprehensive review of the four foundational studies on the concepts of personal epistemologies which view epistemology as a development model. This included a brief review of the alternate position of viewing epistemologies as a set of beliefs. This was purposeful to elaborate on the nuances and complexities inherent in each of the four development models, each based on significant longitudinal studies prior to applying the concepts of epistemological development in the context of this study. Each of the developmental models reviewed had different student populations studied across general university education, and involved a large number of students studied over a longitudinal period. These were critiqued to show the different stages or perspectives, and commonalities and differences from which students' progress from a naïve to more sophisticated epistemological beliefs. While, these stages are described in a qualitatively different way and progressed occurred at different stages, a 'shift' or transformation in each model was common across all the models. While Perry's (1970) landmark study was instrumental in the majority of studies on student development in university, particularly using a qualitative approach, none have applied Perry's Model to the field of medical education. This was followed by an outline of the four hypothesised dimensions of personal epistemological theories, proposed by Hofer and Pintrich (1997), which were informed primarily from the development models. This chapter also highlighted the lack of application of the concepts of personal epistemology in medical education, the lack of studies in this area, and implications for this study.

CHAPTER 3: RESEARCH DESIGN

Introduction

This chapter describes the research design and methods used to address the research questions. The purpose of this research was to investigate how epistemological beliefs are conceptualised by second-year medical students in the context of a constructivist medical program with a PBL philosophy. The chapter provides details on the research participants, the setting, and the educational program. It describes the process of inductive analysis and interpretation of results based on the theoretical framework of personal epistemology. In addition, it describes the process of constructing narratives from research interviews to report and describe the main findings. The research study initially began as an investigation into how second-year medical students made sense of, and interpreted, their experience of being a self-directed learner? However, in response to the flexible and evolving process of qualitative research, the major themes that emerged were students' interpretations of the nature of knowledge and knowing. As a result, the study evolved to conceptualise their personal epistemological beliefs. The research design reflects the elements of the original inquiry into the nature of self-directed learning and self-assessment.

Qualitative Research

A qualitative research design and philosophy provided the framework to address the research questions. This paradigm enables researchers to:

> Understand situations in their uniqueness as part of a particular context and the interactions there. This understanding is an end in itself, so that it is not attempting to predict what may happen in the future necessarily, but to understand the nature of that setting. (Patton, 2002, p. 6)

Within qualitative research, a case study approach is often used in education "to describe and analyse some entity in qualitative, complex and comprehensive terms...as it unfolds over a period of time" (Merriam, 1998, p. 29). This approach was adopted to study the lived experience of medical students in their natural setting as they made the transition and adaptation to medical school. More generally, the characteristics of qualitative research relevant to this study are:

- focus of the research is on the nature and essence of the experience.
- philosophical roots are in phenomenology.
- goal of the research is understanding, description and meaning.
- design is flexible, evolving and emergent.
- sample size is small, purposeful and theoretical.
- data is primarily based on interviews with participants.

- researcher is the primary instrument of inductive analysis.
- findings are comprehensive, holistic and richly descriptive. (Merriam, 1998)

Theoretical Perspectives

Crotty (1998) informed the theoretical perspective and Illing (2010) provides the following clarification of terms: "theoretical perspectives provide the framework for research and inform the basic assumptions that guide the research" (p. 283) and "theoretical perspectives are taken here to mean the philosophical stance that lies behind the research methodology" (p. 284). These perspectives are also referred to as research paradigms and were described recently in the journal *Medical Education* as:

> A set of beliefs and practices shared by communities of researchers…the various paradigms are characterised by ontological, epistemological and methodological differences in their approaches to conceptualising and conducting research, and in their contribution toward disciplinary knowledge construction. (Bunnis & Kelly, 2010, p. 360)

Bunnis and Kelly outlined four main research paradigms: positivism, post-positivism, interpretivism, and critical theory commonly used in medical education and the corresponding ontological, epistemological, and methodological assumptions of each. Two of these research paradigms, positivism and interpretivism, are described in Table 10.

Table 10 Research Positivist and Interpretivist Paradigms in Medical Education Research

Research Paradigms	Positivism	Interpretivism
Ontology: What is the nature of reality?	Reality is static and fixed. The world is ordered according to an overarching objective truth.	Reality is subjective and changing. There is no-one ultimate truth.
Epistemology: What is the nature of knowledge?	Knowledge is objective. Generalised theory can be developed to accurately describe the world.	Knowledge is subjective. There are multiple, diverse interpretations of reality. There is no one ultimate or correct way of knowing.
Methodology: What is the nature of the approach to research?	Aim is to discover what exists through prediction and control. Theory established deductively. Uses scientific method. Looks for causality and fundamental laws.	Focuses on understanding. Uses inductive reasoning. Meaning is constructed in the researcher-participant interaction in the natural environment. Gathers diverse interpretations.
Methods: What techniques can be used to gather this information?	Uses quantitative methods including statistical testing of hypotheses (e.g., randomised controlled trials, questionnaires).	Uses qualitative methods to capture various interpretations of a phenomenon (e.g., interviews, use of narrative, case studies).

Adapted from *Research Paradigms in Medical Education Research* (Bunnis & Kelly, 2010, p. 361).

Acknowledgement of Background and Bias of the Researcher

My choice of methods was guided by the aim of capturing and understanding the perspectives of second-year medical students in the context of a problem-based-learning medical program. This required an examination of pre-existing bias in my background in relation to my previous roles in medical education and past experience in the positivist research paradigm described in Table 10.

Addressing Potential Researcher Bias in Relation to Medical Education

Previously, I held academic positions in curriculum development in a graduate-entry (PBL) medical program and postgraduate training program in general practice over a period of five years. Subsequently, I had three years of coordinating the postgraduate education program for junior doctors in hospitals. Therefore, I was familiar with, and had preconceived knowledge of, the theoretical basis of problem-based learning. In addition, I was familiar with the difficulties experienced in the transition from medical school to the role of junior doctors (Interns and Registered Medical Officers) and the distress experienced by junior doctors who struggle with their roles. However, I was not involved in any aspect of curriculum design at the University of Adelaide Medical Program where this study was conducted. While my knowledge of the content and method of delivery of a similar PBL medical program may be seen as a bias, my focus in this research was on understanding *students' interpretations* of their program and, therefore, my background assisted with understanding the nuances of the PBL philosophy.

Addressing Potential Researcher Bias in Design and Conduct of the Study

I developed the research questions, qualitative research design, conducted the focus groups and interviews, and conducted the analysis. Qualitative research was a significant departure from my past experience in quantitative research in systematic reviewing. Patton (2002) stated: "No precise or agreed-on terms describe varieties and processes of qualitative analysis" (p. 453) and noted reviewing 1,000 new books on qualitative research when revising his text on *Qualitative Research & Evaluation Methods* (Patton, 2002). As a novice qualitative researcher, I was initially confused by the array of choices outlined by writers of qualitative research who debate philosophical underpinnings, perspectives and/or paradigms, theoretical perspectives, methodology and methods, and used a variety of these terms interchangeably. Feeling uncomfortable in the qualitative/naturalistic inquiry world, I was influenced by an article titled *What Does "The Discovery of Grounded Theory" Have to Say to Medical Education,* which informed:

> the major differences between grounded theory methodology, and other qualitative research approaches, is its strong emphasis on development of theory, rounded in the experience of data and its attention to rigour in data analysis akin to standards espoused for studies in the positivist tradition. (Harris, 2003, p. 55)

Thereby, I sought to replicate the rigour from systematic reviews into research in medical education, and grounded theory provided the design strategy for this to be achieved. In addition, I noted that the literature on the lack of rigour in qualitative research applied to studies in medical education (Prideaux & Spencer, 2000; Rees & Monrouxe, 2010; Bunnis & Kelly, 2010).

I was drawn to the body of work on grounded theory (Glaser & Strauss, 1967, Strauss & Corbin, 1998) principally because it provided a systematic set of rules and procedures to follow, as opposed to other qualitative texts I consulted (Cresswell, 1998; Denzin & Lincoln, 2000; Lincoln & Guba, 1985; Patton, 2002; Silverman, 2005). Grounded theory was particularly noted for its rigour and provided a systematic way of constructing the theories that illuminate behavior, and this appeared well suited to the nature of my inquiry. However, grounded theory was also criticised in the literature as being too prescriptive as a methodology. To gain perspective, I examined various other research approaches based in ethnography, phenomenology, and sociology (Denzin & Lincoln, 2000; Guba, 1990). However I opted to return to the methodology of grounded theory to begin the analysis.

Subsequently, during the first analytical phase of my research interviews, I immersed myself in the data and followed the procedures of grounded theory systematically. However, after a substantial break from the research and after analysing the data using a variety of procedures and methods, I realised it was not possible to decontextualise the data in this research. I took a more holistic approach to the retrospective accounts of students' lived experience of the medical program and combined thematic and narrative research approaches.

Addressing Potential Researcher Bias in the Process of Analysis

Inherent in a qualitative research design, I was the primary instrument of the inductive analysis and acknowledged my background and previous research bias in undertaking this process. I was informed both by May and Pope's (1995) and Barbour's (2001) criteria for improving rigour in qualitative research for triangulation of data and reporting the results. These steps are outlined in the section on procedures on analysis. More specifically, the triangulation of data was outlined by the process of theoretical triangulation using the analytical techniques of content, thematic, and constant comparative analysis. These processes of analyses resulted in a convergence of similar themes which were congruent to the theories of the nature of knowledge and the nature of knowing (personal epistemological theories). Following the emergence of these findings, the transcripts were re-analysed according to the theoretical framework of personal epistemological beliefs.

The Research Setting

Qualitative researchers study the "settings and people holistically… these are not reduced to variables, but are viewed as a whole…in the context of their pasts and the situations in which they find themselves" (Taylor & Bogdan, 1998, p. 8). The context for this study was a 6-year undergraduate MBBS Program at the University of Adelaide. The mode of delivery and the philosophical educational framework were centred on problem-based learning (PBL). There are three distinctive learning environments in this 6-year medical course. For the first three years, the learning environment is situated primarily within the University. For the fourth and fifth years, the learning environment is primarily in the hospitals and community based clinical settings, with some minor time based at the University. The sixth year is completely based in hospitals or other community clinical settings.

In Years 1 to 3, the program consists of attending small group learning in tutorial rooms, attending whole group lectures, attending resource sessions in laboratories, and participating in small group clinical skills sessions in clinical skills laboratories. In the Year 3 clinical skills program, students progress to spending one day per week outside the University in a hospital and attending tutorials and clinical skills sessions in the hospital's departments.

The second learning environment (Years 4 and 5) has students situated mostly in hospitals, where students rotate through various clinical attachments. The students return to the University environment for a few hours per week for whole class lectures and take part in ward-based clinical teaching rounds and medical school and departmental tutorials.

The third learning environment (Year 6) is situated completely in the hospital setting. Students are part of a clinical team that manages patient care for each hospital ward. The differences from a student in Year 5 are that the Year 6 student has now progressed to a professional role with limited supervised responsibility within a clinical team. This is termed a student internship. Learning is based on the mix of clinical cases in each hospital ward and the ward rounds, and the bed-side is the main teaching and learning environment. This is supplemented by seminars and tutorials in the hospital's teaching rooms.

For the purposes of this research, the focus was on the Years 1 to 3 learning environment. Within this environment, students attend four PBL tutorials to each PBL case, with a tutorial session held every second day. Tutorials are approximately two hours in duration and the PBL case is disclosed progressively over these sessions. Students engage in individual study between these sessions. The learning resources identified by the students in this environment were the PBL cases, lectures, resource sessions, PBL sheets, case wrap-up lectures, year objectives, web-based resource sessions, and access to past examination papers.

The tutors in the medical program were introduced to the principles of student learning in the context of PBL, development of reasoning and mechanistic explanations of processes. During this training period tutors practiced the skills of facilitating a volunteer student group in real time, giving students feedback on their learning, and reflecting on their skill base to be a tutor. For the first year students, the PBL process was modelled through completing a real PBL case in a large group setting using experienced academic staff. During this process, the students were introduced to the PBL reasoning process, the need to integrate and apply knowledge from many disciplines, and to develop strategies to manage their learning.

Purposeful Sampling

A purposeful sampling strategy was selected for this study and was informed by Patton, who reported:

> Qualitative inquiry typically focuses in depth on relatively small samples, even single cases (n = 1), selected purposefully…The logic and power of purposeful sampling lies in selecting information-rich cases for study in depth … ..those from which one can learn a great deal about issues of central importance to the purpose of the inquiry, thus the term purposeful sampling. Studying information-rich cases yield insights and in-depth understanding rather than empirical generalizations. (Patton, 2002, p. 230)

There are various approaches to sampling, and Patton (2002) describes 15 different strategies for purposefully selecting information-rich cases, each with its own logic for that particular strategy. For example, the logic of extreme case sampling is that more may be learned about unusual conditions or extreme outcomes. Extreme case sampling was applicable to this study in the medical program to investigate students who experienced extreme difficulties. However, this would have required inclusion of medical students who had failed or withdrawn from the medical program. Accessing students who had withdrawn would be difficult; therefore, the decision was made that the findings from this study would make a better contribution to the education community by focusing on those students who were currently having difficulty learning within the program.

Therefore, a maximum variation sampling strategy was selected for the advantages it provides in sampling a relatively small number of students. This strategy aims at capturing and describing the central themes that cut across a great deal of variation. For small samples, heterogeneity can be a problem because, by its nature of opposition, individual student cases are so different from each other. The maximum variation sampling strategy turns any apparent weakness into strength by applying the following logic: “Any common patterns that emerge from great variation are of particular interest and value in capturing the core experiences and central, shared aspects or impacts of a phenomenon” (Patton, 2002, p. 235).

The maximum variation criteria for sample selection were based on academic achievement, which was measured by the students' academic rankings after completion of the first-year examinations. These rankings were based on a series of examinations and assessments measuring a range of skills and knowledge over the entire first-year program. The criteria for selection were based on the following steps:

- All first year students were ranked academically.
- Twelve students were selected for interview, with equal numbers by gender.
- Six students were selected from the high achieving group, and six from the low achieving group.
- Invitations to participate in the study were sent to the highest achieving males in order of academic rank, until all three places were filled. The same process applied to the high achieving females.
- Invitations to the lowest achieving males were made in order of rank from lowest and then upwards, until all three places were filled. The same process applied for the low achieving females.

The students in the sample were all from a high school graduating population, typical age was 19 with no previous qualifications. There were no international students.

Preparation for the Research Interviews

Patton (2002) described that qualitative inquiry from a methodological and philosophical perspective aims to minimise "the imposition of predetermined response when gathering data" (p. 153) and questions should be developed in an open-ended manner to enable participants to respond in their own words. Furthermore, Patton (2002) distinguishes three kinds of qualitative, open-ended interviews: informal conversational; general interview guide; and standardised open-ended questions. The interview guide approach was used in this study. Essentially, this is a set of themes which are predetermined prior to commencing the interview but the order and working of the questions are not predetermined. The presence of a predetermined set of themes ensured that the same issues were covered in all interviews while making the data more comprehensive than the open-ended interview or information conversational approach. The interview guide approach also enables researchers to focus on a subject area while remaining "free to explore, probe, and ask questions that will elucidate and illuminate that particular subject" (Patton, 2002, p. 343). The focus of the subject area in this study was the nature and development of self-evaluation. The sequence and wording of questions was left flexible to enable the interview to be

tailored to the individual situation of each student and respond to the pattern and flow of the interviews with students while still covering the essential areas.

The interview guide was informed and developed from two focus groups and two pilot interviews that were conducted prior to the interviews. The focus group questions and pilot interview questions are listed in Appendix A, and the interview guides used for the first and second interviews are listed in Appendix B. These stages in the development of the interview guide resulted in a richness and diversity of responses in the students' own words. In particular, they facilitated a climate in which students disclosed the significant personal impact of participating in the medical program. This was unexpected and contributed to the knowledge of learning in context in a complex and dynamic environment.

Stage 1: Focus Groups: Rationale and Justification

The aim of the focus group was to investigate a range of perspectives from the students on the concept of assessing their own performance within the medical program. Focus groups are an efficient way of gathering exploratory data in the early stages of research in order to generate themes to investigate further in the interviews. A series of exploratory questions were used in the focus groups that were informed by the literature on self-assessment and self-evaluation. While there are many other aspects of focus groups quoted in Patton (2002), the primary justification for these groups was in their function to identify the students' attitudes, priorities, language, and framework of understanding and to provide background knowledge to the researcher which could assist in facilitating the expression of student ideas and experiences that might be left underdeveloped in an interview.

Sampling and Conducting the Focus Groups

A theoretical sample was used to select these focus groups. As reported by Kitzinger (1995), "most focus groups use a theoretical sampling model. The groups can be naturally occurring (for example, work together or study together) and using pre-existing groups allows observations of fragments of interactions that approximate to naturally occurring data" (p. 300). Consent from the University of Adelaide Human Ethics Committee was given to conduct the focus groups.

The students selected for the second-year focus group were part of a pre-existing tutorial group for the second-year subject Medical Personal and Professional Development (MPPD). Recruitment for volunteer focus groups was undertaken by inviting second-year MPPD groups to participate at the end of their regular tutorial, where an outline of the focus group session was discussed. Two focus groups were conducted with second-year students in the tutorial room where they held their regular MPPD tutorials. The groups ranged from 3 to 6 students and the

duration of the focus groups was between 45 and 60 minutes. The questions for these focus groups are listed in Appendix A. The focus groups were recorded, transcribed and reviewed.

The focus groups' findings contributed significantly by identifying five key points based on the students' interpretations of the questions. These were:

1) Students perceived the concept of self-assessment to be associated only with their performance in examinations and not related to the concept of the self.

2) Students perceived self-assessment as an activity related to the end-of-year examination process and not something they engaged in on a day-by-day basis.

3) There was a tendency for students to respond to questions in the collective sense and not as an individual. Students often described *what we did* rather than *what I did.*

4) It was evident that students perceived the topic of self-assessment as complex, especially as the style of the PBL curriculum and learning environment was a significant departure for them from high school and this contributed to their level of frustration and anxiety.

5) Some students tended to blame the style of the curriculum, tutors, and PBL cases for the feelings of frustration, anger and confusion they were experiencing in their learning.

The focus groups made an important contribution in highlighting that the responses from students emphasised the collective approach of students rather than their individual approach. Hence, the questions for the trial interviews were developed to place more emphasis on the use of the word 'you' to elicit individual responses.

Stage 2: Pilot Interviews

Two pilot interviews were completed with two volunteer second-year medical students who had taken part in the focus groups and were, therefore, familiar with the nature of the research inquiry. The interviews were completed in a tutorial room at the Medical School and lasted between 30 and 60 minutes. Four important issues emerged from the pilot interviews. Firstly, the students provided feedback that, prior to the focus group, they had not thought about the concept of self-assessment, but that the experience had prompted them to reflect on it since the discussion. Secondly, the students were more relaxed during the second interview, as was the interviewer. As a result of the rapport established and level of trust that was built, the researcher was able to probe further with the questions and phrases relating to the research questions, and the students responded to this level of probing. Thirdly, upon reflection, it was evident that the concept of self-directed learning and the learning environment was more complex and was also difficult for

students to grasp. Fourthly, an additional strategy was needed to capture the complexity of the phenomenon and the depth and breadth of the students' individual learning experience.

Guided by these issues and by the overall principles of the emerging and inductive nature of the research philosophy, three changes were made to the interviews for the main study. Firstly, personal contact was made with the students prior to the interview being conducted in order to outline briefly the nature of the questions in addition to the requirements for Ethics Approval and Informed Consent Process. This was to give the students time to reflect on the nature of the topic. Secondly, each student was interviewed on two occasions no more than 3 months apart. An interview guide was used for these interviews. Thirdly, in the second interview, students were asked to recount their experience with their last PBL case in a 'think out loud' process style of interviewing (Wineburg, 1998). All of the above refinements were designed to build upon establishing rapport, building trust, and to accommodate the complexity of the problem-based learning environment.

The Research Interviews

Procedures of Consent and Accessing the Participants

Consent was obtained from the University of Adelaide Human Ethics Committee for this study. In accordance with these criteria, 12 students were selected from the Medical School Assessment Database. Student email addresses and telephone contact details for each of the 12 students were provided to the researcher by a third party responsible for this task. The researcher was blinded to the academic ranking of the students, as this avoided the development of any preconceived notions of the students. All of the students who participated had entered medical school straight after high school, had passed first-year medical school on their first attempt, and were in enrolled in the second year of the medical course.

The first communication with the students was by email. In this email, students were provided with details about the researcher's background, status as a full-time student, and interests in self-assessment for medical students. Students were informed that the researcher was not a staff member at the medical school and was not involved in any teaching or assessment within the university. Students were invited to contact the researcher if they were interested in participating in this research study. All 12 students replied and agreed to be interviewed.

Students were emailed the Information Sheet and Consent Form prior to the interview and invited to discuss any questions or concerns. The first interviews were conducted in the medical school in a mutually agreed place, in either a private tutorial room or the researcher's office. The second interview was conducted in a tutorial room which contained a white board. Both interviews were

recorded and transcribed by a professional audio typist. Each interview was numbered and dated, and the students selected a pseudonym of their choice. A copy of the transcript was given to each student for viewing and amendments.

The Interview Process

The First Interview

Prior to commencing the first interview, the contents of the Information Sheet were explained; the transcript amendment process was described; students were advised of the procedures if they had any concerns; and written consent was obtained.

The interview guide (Appendix B) informed the first interview. In general, the students were asked about their experience of learning in medical school in the past two years with a focus on self-directed learning. The introductory question was "Can you tell me what it was like for you in the beginning?" Other questions were on the understanding of the concept of self-assessment; self-directed learning; what helps and what hinders; how do you work out what you know and what you don't know; how do you do this on a day-by-day basis; the impact of the PBL group and any motivational issues. There were no prescribed questions on any of the many learning theories which are frequently ascribed to learning in a medical school. In addition, students raised other issues of a personal nature that had an impact on their learning. The interviews lasted between 45 minutes and 2 hours.

The Second Interview

The students all agreed to participate in a second interview. Prior to this, each student was contacted and it was explained that in the next interview they would be asked to describe the approach they take to a PBL case and how they manage the process of self-directing their learning during these sessions. This is known as the *think-aloud protocol* approach, which aims to capture the "inner thoughts or cognitive processes that illuminate what's going on in a person's head as close to the action as possible" (Patton, 2002, p. 385). The rationale for this approach was to capture the complexity of their thinking processes in action in a PBL context in a learning environment with which they were familiar. Therefore, at the start of the interview, students were asked to reflect back on the last PBL case they had completed and to use this as an example to explain what they were thinking during the process, and to describe this from Session 1 until the end of Session 4. They were invited to 'think out loud' and to use the white board to write up the process as they do when working through a PBL case.

The process of writing on the white board became a useful focal point for raising open-ended questions at various points in the discussion of the PBL process. The themes for these questions

focused on how they know what they know and what they don't know, why this is so, and how they worked that out within the context of the PBL sessions and their private study at home. These interviews lasted between 30 minutes and 90 minutes.

Procedures of Analysis

Introduction

The analysis took an inductive process using a combination of NVivo 5 qualitative research software and Microsoft Word. This was supplemented with computer-based colour-coding to highlight themes and the construction of interview summaries. In addition, hand-coding and identification of major themes and similarities and differences between the students were written up on large sheets of paper as another visual aid.

Steps in the Analysis Process

The following procedures were undertaken in the process of analysis and detailed step-by-step basis for brevity.

1. Notes were made immediately after each interview about the researcher's first insights and these were kept in a research journal. Audio files from the first and second sets of interviews were checked against the written transcripts for any errors. In a second audio review for each interview, notes were made on the transcripts where there was a significant change in student tone or expression or there was a long pause.

NVivo Software Analysis

2. De-identified transcript files were copied and then entered into the NVivo Software package. In keeping with the grounded theory approach, line-by-line coding of the first interviews were completed, generating over 1,000 free nodes which represented coded pieces of the interview transcripts. These nodes were analysed inductively over the course of 6 months, and various ways to reduce the data into categories was explored. Grounded theory procedures were followed, and memos of each step and insight recorded.

3. Working closely with the NVivo program on a line-by-line basis resulted in a fragmentation of the overall picture and context of the data. This was partly due to the complexity of the learning environment accompanied by the process of transition experienced by students in this environment.

4. The most prevalent feature of the interviews was the individual stories from the students in the form of extended narrative recounting significant educational experiences.

Subsequently, the process of attempting to fracture the data using NVivo nodes was discontinued to focus on other approaches to capture the essence of the stories.

5. A different approach was subsequently used and the interviews were re-examined, firstly using a data reductionist approach to build an overview of the whole picture.

Content Analysis

6. A summary of each interview was prepared in dot-point form covering the topics that the students raised. This summary for each of the first interviews was 2-4 pages. A similar process for the second interviews was completed and the summary for each interview was 1-3 pages.

7. This reductionist approach was taken to consolidate the data by identifying and highlighting the major topics and themes that the students discussed. A content analysis from the interview summaries was constructed. This listed all the elements that students raised in relation to the components of their experience and the learning environment. The content analysis provided the factual matter, but did not provide the interpretations that students gave to each of these elements. It helped in that it gave some parameters to the volume of data, but could not illustrate the complexity of the students' interactions with the learning environment.

8. A list of the fixed and variable elements in the learning environment based on students' interpretations of each was prepared from the content analysis. This provided the framework for discussing some of the results.

9. By this stage, it was evident that most students had undergone significant changes in the first two years. Capturing this process of change, combined with the emotional aspects of the interview, was difficult to code using content analysis.

Thematic Analysis

10. Analysis proceeded to developing a list of themes that each student had discussed in their interviews. This list was between 1-2 pages for each student. Up until this point, the interviews were reviewed as a whole and were not segregated into their high and low categories of academic rankings. This was to preserve the inductive approach to analysis without placing any pre-conceived categories on the data.

11. As the analysis proceeded, early patterns emerged and, subsequently, the analysis explored differences between these two categories of academically ranked students. Summaries of the themes for students from the lowest (L) academic ranking category were reviewed as a whole group. One of these interviews was selected as the master

set of thematic headings. This set was used as the basis of comparison with the other interviews in the (L) group of students. New themes were added to this master list and others themes that were similar were collapsed into this list. This constant comparison approach resulted in a list of theme headings collectively incorporating all the data from the interviews in the (L) category. This step was repeated for each of the 6 students in the highest (H) academic ranking category.

12. The themes from the H category master list were compared with the L category themes and consolidated where relevant. During this constant comparison, patterns were emerging in the data. These patterns were related to the key differences between the L and H groups of students, and a list of these differences was made.

13. Further analytical work based on these themes of similarities and differences between the two academically ranked groups was completed. The major themes that emerged were: containment of knowledge, elaboration of knowledge, dependency in learning, guidance in learning, openness to new interpretations of knowledge, confidence and identity as a learner, certainty of knowledge, boundaries of knowledge, and understanding of knowledge. Associated with these were a set of sub-themes in relation to the level of influence of the role of the tutor, peers, PBL group dynamics, and the overall PBL process. Over-arching these themes was the process of adapting from one learning environment to another (high school to medical school) and a further process of adaptation over the first two years of medical school.

14. Following the emergence of these themes, the literature on the nature of knowledge and the nature of knowing (epistemological beliefs) was reviewed.

15. Overall, the process of analysis had incorporated inductive, content, thematic, and constant comparative analysis. These approaches represented triangulation of the data from multiple analytical techniques. Each of these validated significant differences in the data between students in the L and H groups.

Theoretical Framework Analysis

16. The major differences were further explored in relation to the theories of personal epistemology, which were then tentatively applied to the themes that emerged from the analysis.

17. The final stage of the analysis was exploring the existing theoretical dimensions of personal epistemological theories (these dimensions were outlined in Chapter 2 and are referred to in the forthcoming Chapters 5 and 6). Each line of data in the original

transcripts was revisited and examined for epistemological meaning in the context of each student's experience in the learning environment.

18. Firstly, the components in the learning environment that students identified to be of the most epistemological significance were listed. Secondly, segments of the data that related to dimensions of personal epistemology were coded under each of the four dimensions of personal epistemological theory. Segments of data that encompassed more than one dimension were identified with overlapping codes. For example, the codes of simplicity and certainty of knowledge had elements in common. The coded segments between students were compared to get a sense of the breadth and depth of the interpretations among students as a whole, and these comparisons resulted in the emergence of three distinct phases in the results.
19. Segments of data which included each student's extended accounts of episodes of learning that illustrated key aspects of epistemological beliefs were identified from each interview and analysed according to whether they represented naïve or sophisticated epistemological beliefs.
20. These analytic approaches enabled an in-depth analysis of students' experiences of the course of their first two years in a medical program. In addition, they facilitated a more holistic interpretation of students' experiences firmly grounded within a strong theoretical framework of personal epistemological theories. The methodology for reporting these results is described in the next section.

This process was recorded in a series of hand written notebooks, hand coding of transcripts, computer coding outputs and word processing documents which detailed stages of the process.

Method for Reporting the Results

Introduction

The aim of reporting the results was to achieve a balance between description, interpretation and analysis of material concerning complex epistemological theories in an equally complex learning environment. A narrative approach enabled the epistemological perspectives to be expressed in the students' own words in the context of how they perceived the medical school learning environment. The main findings are reported according to the theoretical framework of personal epistemological theory. Chapter 5 is the first and foundational results chapter for examining the dimensions of personal epistemology in more depth, and it lays the groundwork for the epistemological analysis of medical school and PBL in Chapters 6 and 7, respectively.

Rationale for the Structure of Results

The analysis revealed three distinct phases within the students' interpretations of learning in medical school, and the approach for reporting each is outlined. In Chapter 5 on students' epistemological interpretations of high school, the analytical approach was determined by three factors. First, the concept of learning in high school was much less complex than in medical school, and it was not as difficult to describe the elements of epistemological significance that students discussed in that context. Second, the purpose was to delineate the four theoretical dimensions of personal epistemology: the certainty, simplicity, source, and justification of knowledge. The rationale was to embed these foundational concepts with examples of these dimensions in preparation for the reader to understand the more complex setting in medical school. Thirdly, to represent the interpretations of all the second-year students that were interviewed and to show the full range of *diversity* and *commonality*. This is in comparison with the next Chapters 6 and 7, where eight students illustrate the diversity of interpretation of personal epistemology.

Methods for Reporting the Results

The process of constructing narratives began after the 19 steps which were outlined in the procedures of analysis section in this chapter. The literature on constructing narratives to report the findings of the thematic analysis was reviewed. This was guided in general terms by the *Handbook of Narrative Inquiry* (Clandinin, 2007) and, more specific to this research, by an article entitled *Telling Stories: Narrative Approaches in Qualitative Research* (Sandelowski, 1991). Using narratives enabled students' experiences in a medical program, which exceeded the complexities of a more traditional university program, to be portrayed in a realistic and interpretative manner.

The research interviews conducted with second-year medical students yielded over 110,000 words of data. The process of analysis identified that medical students from different academic rankings held different concepts of the nature of knowledge and the nature of knowing. The challenge of reporting these findings was to achieve a balance of description and interpretation to illustrate the complex theories of personal epistemology within the context of an equally complex learning environment.

In reporting the results of qualitative research, Patton (2002) advises that "one of the major decisions to be made about the process of data reduction for reporting involves how much description to include… to allow the reader to enter into the situation and thoughts of the people" (p. 502). To achieve this balance, Patton cautions that "description must not be so thin as to remove context or meaning… as qualitative analysis is grounded in thick description" (p. 503). The concept of thick description "goes beyond mere facts…. it establishes the significance of an

experience or the sequence of events for the persons in question…the voices, feelings, actions and meanings of interacting individuals are heard*"* (Denzin, 1989, p. 83). This enables connections to be made between individual cases so the "perspectives and experiences of those persons…. be grasped, interpreted, and understood" (Denzin, 1989, p. 105).

Additionally, in the organising and reporting of qualitative data, Patton provides three options: the case study approach, the analytical framework approach, and the storytelling approach, which he advises are not mutually exclusive. A combination of these three approaches was used to organise and report the findings of this research. For example, firstly, this research used a case study approach to compare, contrast and report the individual and collective experience of students. Secondly, the analysis was grounded in an analytical framework which consisted of personal epistemological theories. Thirdly, the thick description from the research interviews was crafted into first-person student narratives using the storytelling approach. The storytelling approach enabled the epistemological perspectives from each student to be conveyed in their own words without removing context and meaning. Crafting student narratives enabled the right balance to be achieved between descriptions, interpretation, and reporting in order to illustrate the findings of this research.

Linking Narrative, Storytelling and Craftsmanship

This section will outline and link the aspects of narrative, storytelling and craftsmanship to substantiate the choice of narrative from the qualitative tradition (Andrews, Squire & Tambouko, 2008; Phillips, MacGiolla & Callaghan, 2002; Polkinghorne, 1998). Narrative means to know, and storytelling involves knowledge production and shaping of experience, not simply transparent recounting of events (Bleakley, 2005). In qualitative research, narrative refers to "the construction and presentation of meaning in a written form which allows for events, human actions and experiential accounts to be interpreted and configured into an integrated whole" (Goodfellow, 1998, p. 175). Similarly, narratives provide a sense of organisation and interpretation to events which do not always occur sequentially, therefore giving order to what is otherwise a series of tumultuous events (Bal, 1997; Murray, 2003). Therefore, the depth, breadth and variation of students' experiences over the first two years in medical school is well suited by and justifies the use of narratives to illustrate the results.

Using the framework of a story is well-established in qualitative research (Patton, 2002) and story is referred to as a particular kind of narrative. Goodfellow (1998) describes story as a "symbolic representation of events (or the elucidation of subject matter) around a central theme or plot… and an illumination of new insights gained through that transformation" (p. 176). In *The call of Stories: Teaching and the Moral Imagination,* Coles (1989) used a storytelling approach to teaching in psychiatry. Furthermore, in medical education research, in the article *Stories as Data,*

Data as Stories: Making Sense of Narrative Inquiry in Clinical Education, Bleakley (2005) advocated for stories in clinical research. His argument was that structured qualitative research analytical methods "tend to lose the concrete story and its emotional impact to abstract categorisations" (p. 535). To redress this imbalance between the more structured analytical methods and storytelling approaches, he recommended that researchers use more holistic methods by "creating a story as a research product and a way of capturing elements otherwise lost" (Bleakley, 2005, p. 535). Furthermore, this requires a researcher "who can synthesize and has developed narrative competence as applied knowledge of literary devices" (p. 535). The sense of craftsmanship in narratives was supported by Denzin (1997), who refers to narratives as "an interpretative structure that attempts to link audience, text, structure, empirical inquiry and lived experience" (p. 244).

The Narrative Form

The narrative form was pioneered by Labov and Waletzky (1967) and further developed by Labov (1972). This can take two main forms: thematic analysis or structural analysis. A thematic analysis guided this study in conjunction with a storytelling approach from the qualitative research paradigm. Structural analysis was considered, as it was developed by Labov (1972) in his research on youth and learning and logical thinking. However this form of narrative is from the field of linguistics and focuses on the *telling* of the story and not the *content* of the story and is "tied to theorising in narratology that initially interrogated literary texts" (Riessman, 2009, p. 78). Thematic analysis was deemed to be more suited to this study than structural analysis, due to the significant themes that emerged from the interviews.

The work of Williams (1984) led the way in the scholarship of the thematic narrative form. Williams conducted 30 interviews with individuals who were diagnosed with arthritis. He found the interviewees responded with long stories about their experience and expanded on these stories during the process of his contact with them. To report the results, he constructed three case studies to illustrate the process of making sense of the genesis of disability. Riessman (2008) reported that the significance of this approach lay in selecting cases "not selected to be representative statistically, but instead to develop a theoretical argument: the arrival of chronic illness initiates a process of cognitive reorganization – meaning making" (p. 55). Riessman points out that "Williams does not fracture the account into thematic categories as grounded theory coding would do, but interprets it as a whole" (p. 57). This approach enabled Williams to compare and contrast the strikingly different explanations he received from the participants in the genesis of their disability.

Crafting the Narratives in this Study

In *Narrative Methods for the Human Sciences*, Riessman (2008) reviewed the construction of thematic narratives from four major researchers in the field: Williams (1984), Ewick and Silby (2003), Tamboukou (2002), and Cain (1991). The method used by Williams was adapted for this study as it was deemed the most applicable to illustrate the development and variation of students' epistemological beliefs. Key excerpts from Riessman's review of William's method, which informed the method of constructing student narratives, are reproduced here:

> The investigator works with a single interview at a time, isolating and ordering relevant episodes of speech into a chronological account … the researcher zooms in, identifying the underlying assumptions in each account and naming (coding) them. Particular cases are then selected to illustrate general patterns – range and variation – and the underlying assumptions in each account are compared. Williams reproduces excerpts or segments (some fairly lengthy from the long interviews) that are interspersed in the written report with his interpretation and references to theoretical formulation, and references to prior theory. Speech quoted from interviews is 'cleaned up' to some degree, for his texts erase dysfluencies, break offs, interviewer utterances and other common features of interview conversations….Investigators in the thematic narrative tradition typically pay little attention to how a story unfolds in conversational exchange or the questioners role in constituting it.… In the written report, it appears that a biographical account emerges "full blown" from the "self" of the narrator, rather than in conversation between a teller and a particular questioner. (Riessman, 2008, pp. 58-59)

Narratives were constructed from each of the two interviews with 12 students, resulting in 24 narratives. Four of these are included in the Appendices. Sixteen narratives were further consolidated for brevity for inclusion in results Chapters 6 and 7 to accompany the analysis. These narratives were purposely selected from eight of the 12 students and represent the variation, depth and breadth of views within this group of students. They serve as an important interpretative structure to illustrate the main findings in an effort to "link audience, text, structure, empirical inquiry and lived experience" (Denzin, 1997, p. 244) in the qualitative research tradition.

Theoretical Framework for the Analysis

The theoretical framework of personal epistemological beliefs proposed by Hofer and Pintrich (1997) was used as the central theme to interpret the lived experience of the students in their first two years of medical school. This framework suggests that individual theories about knowledge and knowing are comprised of four dimensions that can each be expressed as a continuum from naïve to sophisticated epistemological beliefs. These dimensions are in two areas: the nature of knowledge (what one believes knowledge is) and the nature, or process, of knowing (how one comes to know). Within nature of knowledge are the dimensions *certainty of knowledge* and

simplicity of knowledge, and within the area of nature of knowing are the dimensions *source of knowledge* and *justification for knowing* (Hofer, 2002).

Schwab's Educational Framework

To present the results of Chapters 5 and 6, an educational framework was used to identify the components of learning and teaching practices of epistemological significance that informed the analysis, based on the four dimensions of personal epistemological theory. The framework was developed by Schwab (1978) and supported by Hofer, who recommends this as "a broad framework for thinking about what occurs in educational settings" (Hofer, 2004, p. 133). The framework contains four 'commonplaces' to guide investigations into what occurs in educational settings. These commonplaces are: The Teacher, The Learner, Subject Matter, and Learning Environment.

The selection of Schwab's framework was guided by three reasons. Firstly, it provided a form of educational scaffolding to assist the identification of components of the learning and teaching practices in high school. Secondly, the simplicity and precision of the framework enabled a comparison of commonplaces across educational settings particularly relevant to this study which investigated diverse educational settings, namely: high school, medical school, and PBL. Thirdly, it provided an interpretive framework to elucidate the process of describing the complex nature of personal epistemological theory and concepts.

Chapter Summary

This chapter has outlined the research design, methodology, research setting, interviewing process, analytical process, and method of reporting the results. Particular attention was given to steps in the triangulation of the data and the final analytical process of applying the framework of personal epistemological theories to the findings that converged from three analytical methods. The methods and process of constructing narrative in the qualitative research tradition were outlined in detail, and potential bias inherent in the researcher was acknowledged.

CHAPTER 4: MEET THE STUDENTS

Introduction

This chapter contains a series of vignettes designed to introduce the students, contextualise the study and provide background information. The vignettes are purposely placed early in the thesis to acknowledge the voice of each student. They were crafted from episodes in their interviews which were interpreted to be particularly salient for each student and titled based on quotes from each student that reflected his/her experience.

Background

Construction of the vignettes was inspired from the text Slices of Life: Qualitative Research Snapshots (Green, 2002). It is important to note that the vignettes differ from the narratives (described in Chapter 3) which are the research output that accompanies the analysis. The purpose of the vignettes was to demonstrate a small slice of life from each student's personal experience in medical school and a pseudonym was used to allow the reader to identify each student throughout the subsequent results chapters. They also introduce some of the components in the research setting in a less formal way, such as the:

- Learning environment in the medical program,
- Nature of the different academic tasks required of the students,
- Nature of the problem-based-learning curriculum,
- Impact of students' prior learning experience in high school, and
- Variation of student's interpretations of all of the above.

The Affective Domain of Learning

The vignettes also introduce the affective domain of learning, which is such constructs as attitudes, values, beliefs, opinions, interests, and motivation. They emphasise a feeling tone, an emotion, or a degree of acceptance or rejection (Krathwohl, Bloom & Masia, 1973). It was important to acknowledge the validity of the affective domain in addition to the cognitive constructive domain of problem-based learning. Additional important themes that emerged from the interviews include the students' personal identity, motivations, epistemic doubt, competition, confidence, and competence in learning. Aspects of these are shown in the vignettes. While it was outside the scope of this research (which focused on students' personal epistemological beliefs), it is important to acknowledge the impact of the strong emotional elements expressed by the students in relation to their learning experience.

Reese: You can never really escape it!

Living with a lot of the other med students [at Residential College] you see some people at our level already only stop to sleep and eat and that's it. Not even at exam time, like right now they're going to bed 3 or 4 a.m. every day. It's so hard! When other people seem to just go out all the time and do nothing and you just think "how much should I be doing, should I be somewhere in between or should I be going out; what sort of books should I be using?" The hardest thing with this is because you don't know what you need to know.

How am I coping? I'm good now but, yeah, last year we all just all lost it before exams. I try and do a bit of sport but even so, - I take a textbook to the gym and things like that because there's always "I should be studying" because there are people that just study and eat and study and eat!

You can never really escape it, like maybe it is because I'm here at college so I see these people out of uni, but you can never really escape it. Even just going out during the week I feel bad for doing that, just because I know that everyone else is back there studying and I should be doing that too. It sounds horrible actually when I think about it.

Sometimes I really, really need to go home [interstate] ... just go home for a weekend, like catch the overnight bus or train. Just to get out of here. You go to dinner and there's people studying at the table and it's in your face 24/7 and you can't get away from that. It does bring you down a bit.

Bailey: I always had a great admiration for doctors

The reason that I chose to study medicine is I always had a great admiration for the doctors who I'd met and interacted with. I'd always admired what they were doing. Not just on an academic level, but also a personal level. I always admired them for their dedication and genuine concern for the wellbeing of others and the role in which they were playing in society. I'd always admired those people and I think it's natural when you admire someone that as you grow up you decide that you want to be like that. So I think that played a large role in motivating me to go about things the way I do.

So from external influence builds an internal influence and for yourself you have that feeling you know where you want to be and you know where you want to go and you know it's up to you to get there. So there's no-one pushing me to study other than myself. Not since I was young have I ever been told to work. It's always been a self-directed drive because I know where I want to go and I know that it's only up to me to get there.

I see it a lot, people with very strong ability and they decide in their own mind that they're struggling or that they haven't pushed themselves hard enough or it's not going to be enough to pass. I've seen that to be a problem, but for me I think that I have a lot of self-confidence in my own ability and so I haven't much of a problem.

Jamie: I could do a Bachelor of Arts and be fine and not worry!

Friends help me a lot because everyone has down days where they're just like 'I don't even know why I'm doing this course. I could just go do a Bachelor of Arts and be fine and not have to do anything and not worry about this.' But having your friends there to support you because they're doing the same course they know what you're going through and friends in med just support each other, as corny as that might sound.

My motivation is definitely thinking long term. Yes - there is a lot of work, and yes - it does get hard, but if I'm able to improve someone's quality of life or even extend the length of their life then it's going to be worthwhile - so just keep telling yourself that - 6 years later and then you'll be able to make a difference.

Jordan: Everyone in the course is a caring, sharing individual really

I think you need to come with a really open mind. A lot of people stressed out last year [Year 1] with the whole PBL process and didn't really react to it very well and they didn't like it. They just wanted to be taught stuff rather than go away and teach themselves. Personally, I didn't really find any problems with it.

I guess you can't really come into it and look at medicine through the eyes of school because (1) We teach ourselves and (2) We don't get marked.

When you start here you just throw that whole idea of somebody else assessing you out the window really! So the assessments have to come from yourself rather than med school. So I think even the whole concept of self- assessment is something that you need to develop within yourself. The universal paranoia within med students is to fail so to stay as far away from that as possible.

One of the biggest motivators is having to face the fact that you might have to repeat a year and lose all – not lose all your friends –but you're slotted in amongst this group of complete strangers again. I think I could have a chat with anyone and yeah, I'm just a people person and it's a lot of fun to be with those people. One really good thing is the fact that we're not competing against each other, because everyone in the course is really sort of a caring, sharing individual really.

Gordon: You've got to beat the person next to you

I went to an all-boys private school and like bigoted... it was really bad. I had to move interstate, I had to leave my family and all that kind of stuff and where I was living. There was this big segregation like at my school. There was the Asian group and there was white group and that kind of stuff and I was caught in the middle because I wanted to go surfing with all my white mates but I took all my subjects and I played chess with the Asian guys so I always found myself in the middle. But coming to Adelaide was simply a breath of fresh air because all these people were sort of a mix. Friends were female and friends were gay and it was a big slap in the face and it was really nice and I learnt a lot about myself and stuff with girls, and all that kind of junk of as well.

I had to sort of sit back and evaluate what was important to me and having some periods being away from family. I'd ring and say to my mum, 'Oh I hate this, I want to go home'. I thought - by the end of the sixth year I am going to be spending sort of, you know, 45 weeks of a year here and I'm not sort of being your son anymore. So I could either sit here and mope for six years or I could enjoy it.

Back in high school, I enjoyed being the person that understood things. It's nice to know things, to understand things, but then that switches around [in Year 12]. At the end of the day it doesn't matter if you understand it or not. You've got to beat the person next to you if you want to get into the medical course you want to do… you need to beat them. I guess I don't have to worry about beating the person next to me now but later on that will have to be a problem but for the time being trying to marry the two is very difficult - beating the person next to you but also enjoying it all the way. I wanted to do well and you had to be hard, it's just how it was, and so I think I was a bit like at the start of the year, but once I realised that - I don't know, I changed a lot. I felt a lot better, finding friends I was comfortable around and my learning as well.

Brita: I miss tests; I really do!

It's quite scary because it's a whole big thing in high school to fail, you've got to do absolutely nothing or have real problems with what you are trying to learn but to me it seems horrible that you could be trying your best and still fail in this course. I just feel frustrated because I'm doing my best and there's no certainty that I might pass. It probably is the uncertainty that really gets to me. It's irrational really as I might not have understood everything but you only need to understand half of it to pass.

It's easy to be fooled. My friend, there was a guy in her group and he was determined that what he knew was right, even though the lecturer had said "No, that's not right". So she and he had a really big argument in their group and so everyone was ganging up on this one person because they'd all heard the lecturer say he was wrong. But if they hadn't been paying attention, then perhaps they could have believed him because he was so vocal and so confident and you could have been fooled into thinking that he knew what he was on about.

Cameron: Do you want to do something smart people do?

Even when I was a kid - I went to not the best school and I set really low goals and I wanted to be a bank teller or something like that, nothing where you had to go to university or anything. Then I wanted to be a chef and then once I hit high school they [the teachers] realised I had some intelligence and said "Do you want to do something that's sort of worthwhile in life. Something smart people do?" Then I thought about law and medicine and everything....but medicine was always in the back of my head but I never thought I could get there. When I was younger you think: "Oh, I'd love to do that." I suppose once I hit high school, the realisation came that I can get there!

I find a lot of people are really panicking already about the exams but I'm just like relaxed and I feel like I can just switch of and when I go home… it's just like take the weight of my shoulders and then it just gives me time to reflect and think about what I've been doing over the day.

A lot of people living in colleges go back and it's the same environment sort of thing, so I guess having that change in environment from uni to home makes that difference and it gives me the chance to just sit and have a think about things.

Tristan: I used to be a perfectionist

I think I'm quite lazy. I used to be a perfectionist and that would have motivated me. I want to do well, but it didn't fuss me if I didn't get, you know, top of the class. That wasn't an issue any more. Whereas I know in high school I would have been quite disturbed by, you know getting less than 80% because you want to be, like especially year 12 you want to be getting better than greater than 95% if you want to be guaranteed really good scores to get you into something like medicine.

I did realise that medicine was a stressful course compared to others in terms of workload and the demand that was placed on you. But I think, on the other side, I still had the notion that university life itself was not stressful. So it kind of counterbalanced and I think it's a bit more personal for me, but yeah, I think the stress is not that good for me so I just lay off a bit. I was just thinking maybe I should try and get a bit more out of uni life itself rather than just focus on studying all the time. I know obviously the demands would be greater but at the same time I didn't place the same expectations on myself. I didn't want the stress.

Catherine: I'm always worried

My family are very supportive and don't really ask too much about how I'm going. They'll always say oh, you know, 'Do you need any help? Do you need any books or anything like that?' If I haven't been working too hard I'll feel a bit guilty and I'll say yeah…. I'll think I'd better study, they really care about me. So family motivates me and my goal motivates me to want to study. This year I've been able to refine my self-assessment and all of that and I've studied a bit harder as well, so I'm not as scared, but I'm still pretty worried. I'm always worried. I always worry. It should be okay, hopefully.

Fear is a big motivation for me because I don't want to fail. I'm very scared because I like my friends, I like my year and I'm enjoying myself. Like, just now we had a resource session, I kind of seen some things and I've got to rush...I've got to go and do that now.

Marilyn: I could just do it at home

I think it was just too much, too much of a change. The tutor wasn't much use in getting the group to work well together and we had one very dominant member who knew what was going on. He'd get up and lecture a bit and that wasn't curbed by the tutor and we didn't - other members of the group - didn't know that we were meant to not be doing it - because we'd never done it before. I didn't really know what I was meant to be doing. I just felt like I was completely swamped for the first semester. It was a bit of a write-off for me.

I went by the lectures and by resource sessions and the material we were given to learn for that and I suppose even though it wasn't much of a group, we still got a sense of what other people were learning. It got a bit better for the next term because we had a better tutor and then a lot better one in second semester and I had a better idea of what I was meant to be doing by then.

I worked a lot harder because the next tutor had high expectations of what the group should be doing and she was very proactive about making sure everybody had something to say. She gave me feedback about needing to make a contribution and she made the more dominant members of the group not talk as much. She made it quite explicit how we were to do it, work as a group; she was clear about what she wanted us to learn. She gave very good feedback and that sort of thing. I think that got me on the right track.

I guess I feel PBL isn't all that reliable sometimes. If we have a rubbishy kind of session and no-one's done any work because it's the end of the week, and it's a nice day outside and no-one wants to be there, so we don't really talk about anything other than in a superficial way. Once or twice when I really haven't been enjoying PBL I just thought "Oh well, I could just do it at home".

David: You just sort of pick up what you have to do

You just sort of pick up what you have to do and get just get a feeling. You just stumble across things in doing your reading and they sort of point you in the right direction. Basically it just comes down to where the group has gone. I think everyone really looks off each other. Basically just look at what other people have done. You can generally tell the people that know what they are doing. They might not even say it, but yes, they know what they're doing.

Motivation…for me it's mainly fear of failure. Yes, just finish - just to finish and get out of Med School as fast as possible. I really can't wait to get out of these pre-clinical years. I really can't wait to get onto the wards and learning that way, but we have to know the theory first. Yes, I can't actually wait to get out to the hospitals.

Beth: Keeping Up with Appearances

I find keeping up with my boyfriend is a big thing and I don't like seeming to like not impress him. It sounds stupid (laugh). Even though he's not necessarily better than the others, he's just very strategic in how he goes about it. The other night we were having a discussion about this sort of motivation and how you strategically get through it and what you do at this stage when you're so close to exams.

I guess in that there's a whole saving face thing. I don't want to look stupid. I think of him - being less distracted by outside influences and very on top of things - whereas I know I haven't done as much work. We're from really different backgrounds and he's a very naturally competitive person and even though it isn't supposedly competitive I know that he likes to do very well. I think he wants to take the surgical stream whereas I'm not really that interested in that.

I guess you can't help but compare yourself to other people and how much they've done, and it's not always a good indicator because I think people aren't always honest and open about how much they've done or where they're up to. I think in men, often a lot of it has to do with appearances and keeping up the appearance of knowing what you're doing.

Chapter Summary

Overall, the vignettes portray a small slice of life from each medical student and convey the diversity of students' personal backgrounds and their attitudes, beliefs, and emotions in relation to adapting to the medical program. For example, the motivation of fear of failure emerged as a salient point. In addition, a sense of strong kinship between the students emerged as a coping mechanism to counter-balance this fear.

They also introduced differences in students' interpretations of the same learning environment. For example, some students experienced a lack of confidence in relation to learning in medical school and focused on the more negative emotions, such as anger, fear, confusion and anxiety. On the opposite end of the scale, the independent nature of the medical program was identified as having more positive attributes by students who displayed a high degree of confidence.

CHAPTER 5: EPISTEMOLOGICAL REFLECTIONS ON HIGH SCHOOL IN MAKING SENSE OF MEDICAL SCHOOL

Introduction

The study of personal epistemology addresses "the theories and beliefs that individuals hold about knowledge and knowing and the way in which such epistemological perspectives are related to academic learning" (Hofer, 2004, p. 120). The aim of this study was to investigate the beliefs that second-year medical students hold about knowledge and knowing and the way in which these epistemological perspectives are related to academic learning in medical school. The interviews revealed that medical students' prior learning experience in high school had a major impact on their transition and adaptation to medical school. In some cases, there was evidence of mal-adaptation to the problem-based learning environment. This was a consequence of the personal epistemological beliefs entrenched from student's learning experience in high school.

The results are disclosed progressively and begin more broadly with the epistemological analysis of students' experience in high school (Chapter 5), followed by analysis of their adaptation over the first two years in medical school (Chapter 6), and conclude, more specifically, with an epistemological analysis of the process they engage in individually when working through a typical PBL case (Chapter 7).

This chapter provides the foundational perspective into the epistemological beliefs that students described during high school, shows how learning and teaching practices are interpreted by the students, and how these interact and influence the development of their epistemological beliefs.

Application of an Educational Framework

As described in Chapter 3, Schwab's educational framework was used to identify the components of learning and teaching practices of epistemological significance which informed the analysis. The framework contains four 'commonplaces' to guide investigations into what occurs in educational settings; these are: The Teacher, The Learner, Subject Matter, and Learning Environment. The results of the content analysis of components of the learning environment in both high school and medical school were categorised into Schwab's model to enable comparison between the two educational settings. The application of this model to the high school setting resulted in the following components:

- The Teacher: Viewed as a designated teacher for each subject with content expertise.
- The Learner: Viewed as teacher-directed, learned individually, examined regularly.

- Subject Matter: Individual subjects with set texts and syllabus-defined textbook.
- Learning Environment: Primarily classroom based.

A Worked Example of Epistemological Analysis of High School

The following example is provided in order to illustrate the process of analysis using Schwab's framework to identify the components of learning and teaching practices which were of epistemological significance and to establish whether there was any evidence and representation of the four dimensions of personal epistemology: certainty of knowledge, simplicity of knowledge, source of knowledge, and justification of knowing in the context of the students' experience in high school. Firstly, this required an identification of the components of the learning and teaching practices that were interpreted to be of epistemological significance for each student. Secondly, these components were analysed to establish which of the four dimensions of personal epistemology they most represented and, thirdly, these were classified as examples on the naïve or sophisticated end of the scale.

In summary, this process required an understanding and interpretation of individual students' experiences via application of an educational framework that enabled analysis based on a theoretical model of personal epistemology. The following excerpt from Brita's experience of learning in high school is presented to illustrate this process.

Brita reported in an interview (the words in italics highlight key words in the analysis of the transcript):

> I'm *used to* having people tell me exactly what I need to know from high school. I'm *just used to* having a teacher say 'Right, read Chapter 6 or whatever, everything's in there! (Brita, Interview 2, page 1, line 7)

This excerpt is interpreted to be of epistemological significance to the dimension of the Source of Knowledge. This is an aspect of knowing that refers to the locus of knowledge. At lower levels, knowledge is perceived as originating outside the self and residing in external authority from which it may be transmitted. A major turning point in this dimension is the evolving concept of the self as knower. The person, previously a holder of meaning, becomes a maker of meaning. There is a shift of knowing in the higher stages, with the knower moving from spectator to active constructor of meaning. At higher levels, knowledge is constructed in an interaction with the environment and others.

Brita's epistemological beliefs were influenced by how she perceived the role of her Teacher as the authority and, therefore, the source and transmitter of knowledge. In her role as Learner, Brita perceived knowledge as originating outside the self and residing in external authority. In relation to Subject Matter, the key component was the textbook, which reinforced that knowledge could

be transmitted, and her experience of the Learning Environment, where she was used to having people tell her what to learn, how much to learn and from what source, was indicative of Brita's familiarity of this environment. Based on this evidence, it was interpreted that Brita held naïve epistemological beliefs on the dimension of the source of knowledge.

Epistemological Analysis of High School

This section explores the theoretical dimensions of personal epistemology in the context of the students' prior learning environments in high school. The rationale was to methodically illustrate these dimensions and embed these concepts in a traditional educational environment that was less complex than the constructivist PBL medical program. The descriptions students provided about the learning and teaching practices in high school are illustrated, followed by interpretation based on their epistemological significance. These results are analysed and reported according to the four dimensions of personal epistemology: the certainty and simplicity of knowledge, followed by the source and justification of knowing.

The Dimension of the Certainty of Knowledge

This construct refers to how an individual views the certainty of knowledge as being of a fixed nature through to a more fluid nature. At the lower levels, individuals view knowledge as fixed and absolute, black and white, right and wrong. These are expressed as naïve epistemological beliefs. At higher levels, individuals view knowledge as fluid and relative, tentative and evolving and modified in exchange with others and the environment. These are sophisticated beliefs on the continuum of this dimension.

Epistemological Interpretations of the Certainty of Knowledge in High School

The components from Schwab's Model that informed the epistemological interpretations of certainty of knowledge were, primarily, the role of the Year 12 syllabus and the function of textbooks in that educational setting. Students described an educational environment where knowledge was fixed and absolute. A major theme that emerged was the fixed boundaries students experienced, which were inherent in the structure of the Year 12 syllabus, and the role of teachers in delivering this curriculum via the textbook. These boundaries reinforced the fixed nature of knowledge as interpreted by the students.

Role of the Syllabus

Tristan provided a very pragmatic approach to the fixed nature of knowledge that was characteristic of his high school experience. He contrasted the difference between high school and medical school as:

> It's different in high school because in high school you're aiming for as close to perfect as possible because that is easily attainable simply because of the depth of the material. A lot of the things that you'd probably encounter in high school are a lot easier than what we have to do [now], so we know exactly what the boundaries are, so what sort of information we have to know and that's, you know, given straight to us by a teacher and it's all contained in one textbook immediately. (Tristan, Intv.1, p.6, L.22)

Tristan's reference to the immediacy of having all the knowledge on hand from one text demonstrates the fixed nature of the certainty of knowledge reinforced in high school. Similarly, David described difficulty with adjusting from the boundaries of the syllabus in high school to what he described as the broadness of medicine:

> At our high school you'd look at one textbook and you get information from there but here your sources of information are very varied and wide and so actually I probably wasted a lot of time just looking. I don't know how I adjusted! In High School you actually have the syllabus saying what you need to know, whereas with Med it's very, very, very broad which has been one of the problems! (David, Intv.1, p.1, L.27)

David attributed his difficulties in medicine to the absence of a syllabus saying "what you need to know". The structure of the syllabus in high school provided the boundaries of knowledge for David and formed his beliefs that knowledge is fixed. Many students described the adjustment from the fixed boundaries in high school as a shock. Jamie endorsed this view:

> When I came here it was a shock. In high school you sort of get spoon fed everything and this is exactly what you need to know and you get given a list and you need to know this and you need to be able to do that. Whereas here can be tricky if you've never done that sort of thing before. (Jamie, Intv.1, p.1, L.8)

Jamie's experience of the shock of adjusting to medical school was attributed to her beliefs of the fixed nature of knowledge she described in high school and her familiarity with that structure. In addition, Brita also described difficulties with the structure: "I felt like I was floundering because it was quite a shock. I think it was more that the boundaries were defined in high school but now the boundaries aren't so defined." (Brita, Intv.1, p.31, L.26)

Most students described struggling with assimilating their past experience of high school in which the fixed nature of knowledge was prevalent into their present learning experience. For some students, the initial shock of this progressed to a positive experience. Gordon portrayed:

> It was a big shock. Year 12 was just tell them what they want to hear and you get points and they're happy. Whereas here, I didn't know what to expect or what standard was required so I almost gave up and that's why I really enjoy med school because I was learning for learning's

> sake and learning because I enjoyed it. It was a hard transition because I didn't know what to do or where to look. (Gordon, Intv.1, p.2, L.10)

Role of the Textbook

Students frequently referred to a prescribed textbook for each subject which contained all the right answers. This reinforced the fixed nature of knowledge that can be learnt from one book. This view presented difficulties for some students adjusting to medical school. They described the change from using one prescribed text to a choice of texts in medical school as overwhelming. Catherine used a very effective analogy between one book and a whole library to describe her experience:

> At the start it was pretty scary because I guess in high school everything is given to you and they [the teachers] basically say if you learn everything in this book then you're fine but when you come into university, and it's like there's a library of books, you can look as much as you want, as much detail or as little detail as you want and it's up to you. (Catherine, Intv.1, p.1, L.5)

Catherine described a belief from high school that all knowledge could be contained in one book. This illustrates a view of the fixed nature of knowledge. In addition, Catherine's experience with her teachers reinforced this belief from the instructions they gave her to learn everything in the book. As a result, Catherine interpreted knowledge to be fixed in nature.

Summary of Certainty of Knowledge

Students viewed the certainty of knowledge in high school to be fixed and absolute. This represents a naïve epistemological belief in this dimension. There was no student evidence of sophisticated levels of knowledge in high school, where knowledge is viewed as fluid and contextual. These findings were based on students' interpretations of the fixed boundaries they experienced in the inherent structure of the high school. These were: the syllabus, the role of teachers in delivering this syllabus, and the central role of one textbook. These boundaries reinforced the fixed nature of knowledge as interpreted by these students.

The Dimension of the Simplicity of Knowledge

This dimension refers to the degree to which an individual views knowledge as an accumulation of facts and isolated, unambiguous pieces of knowledge through to viewing knowledge as highly inter-related concepts. At the lower levels, knowledge is seen as discrete and concrete knowable facts and represents a naïve epistemological belief. At higher levels, knowledge is viewed as relative, contingent and contextual, and this represents a more sophisticated belief.

Epistemological Interpretations of the Simplicity of Knowledge in High School

The components from Schwab's Model that informed the epistemological interpretations of the simplicity of knowledge were, primarily: the role of the textbook, which was strongly related to the examination process, and the role of teachers in conjunction with textbooks and the examination. Students' descriptions of high school were analysed to represent a learning environment where knowledge was viewed as an accumulation of discrete, concrete, knowable facts. Furthermore, these facts could be accurately reproduced by the students for tests and exams. This reinforced their view of knowledge as isolated, unambiguous pieces of knowledge.

Role of the Textbook and Examinations

Gordon aptly described the role of a textbook and included reference to the role of the examinations:

> I found that in high school I had an exam in November and I had a chunk of work that I needed to know - just give us the text and they'll say [the teachers] basically rote learn that and be able to regurgitate it back into an exam at the end of the year, and with that comes no understanding! (Gordon, Intv.1, p.1, L.5)

Gordon used the term "chunk of work" to describe a discrete unit of knowledge and describes the process of regurgitating this back. Furthermore, his realisation that this came with no understanding indicates the requirements in high school were on the lower levels of beliefs (naïve), when compared with the higher levels (sophisticated) where knowledge consists of complex, inter-related concepts.

In a similar manner, Bailey refers to the components of textbooks in conjunction with examinations. He emphasised his experience of the ability to memorise a prescribed amount of content from one textbook and reproduce this knowledge in examinations which validated academic success:

> At my high school, there was a mentality that there was a finite amount of information in maths that if you knew you'd do fine, and especially in some of the science subjects we studied there were textbooks that were written purely for the basis of that course and so if you knew what was in that book, then you knew you'd be fine and in my experience… if you memorised everything in the chemistry text then [there is] not really a question in the exam that you couldn't do, based on what was written in the book. (Bailey, Intv.1, p.8, L.12)

The process Bailey described was of a finite amount of knowledge written in the textbook, which could be memorised and reproduced and this shows that knowledge consisted of discrete, concrete, knowable facts. This represents the naïve level of epistemological beliefs only.

The change from the familiarity of a high school approach was de-stabilising for some students. Jamie describes her difficulty with not having a list to learn in medical school:

> I was used to getting a list of things you need to know. In year 12 you get the syllabus and if you can go down the list and tick everything off then you know that you're on track plus you have more regular tests - we used to have them every week or two weeks. (Jamie, Intv.1, p.4, L.29)

Jamie's experience is representative of viewing knowledge as consisting of discrete knowable facts which can be listed. In addition, Jamie's reliance on regular tests, based on the list, further shows the naïve belief of knowledge in this dimension.

Students frequently expressed a lack of confidence in their academic ability in medical school compared to high school. They attributed this to being able to "know everything" that was expected of them in high school. This is consistent with viewing knowledge as consisting of discrete, knowable facts. Reese describes how she became more comfortable with not being able to know all the facts in medical school:

> Now that we've sat three lots of exams I think I've almost come to terms with the fact that you can't know everything, whereas previously I think I approached medicine like you would your high school exams where *You can know everything! You can study everything and get 100% and know it all,* but with Medicine you can never know everything and the more you know the more you realise you don't know. (Reese, Intv.2, p.18, L.24)

The students were surprisingly open in these interviews and the majority described their previous practices in high school. Cameron embodied this position: "Well I tried my high school methods of learning where I was just trying to rote learn everything and read facts and then try and memorise things but I found that didn't work at all!" (Cameron, Intv.1, p.2, L.13). Once again, this signifies a naïve belief that knowledge consists of discrete knowable facts. Most students described that the academic tasks in high school did not require a sophisticated view of seeing knowledge as highly related concepts.

These views on achieving academic success in high school are exemplified by Gordon:

> They're trying to get us to get an *understanding* and then appreciation of what we're doing and instead of *memorising slabs of text*. And so now I find it for me it really works because if they say 'tell me about something' instead of trying to memorise what they said... it would almost trigger off a cascade of things and stemming from that instead of sitting there and being told what it was all about. So rather than just trying to cram it all in. Now, sort of the whole, holistic view of patients that they don't present as a textbook you'd memorise. (Gordon, Intv.1, p.1, L.10)

Gordon described how medical school enabled him to reassess his views on the simplicity of knowledge that he became acculturated to in high school. He explained his previous academic success by the methods of cramming and memorising facts from a textbook. This method worked

in high school because of the discrete, concrete, knowable facts, characteristic of naïve beliefs of the simplicity of knowledge. Gordon progressed to describe a more sophisticated belief of knowledge required for medical school, where knowledge requires understanding of inter-related concepts. Gordon cleverly used the analogy of patients and textbook to emphasise the whole holistic view of knowledge and show that patients don't present as textbooks that can be memorised. This is in stark contrast to the use of textbooks in high school.

Summary of Simplicity of Knowledge

Students viewed the simplicity of knowledge in high school as an accumulation of discrete and concrete knowable facts. This represents a naïve epistemological belief in this dimension. There was no evidence among the students of the sophisticated level in high school where knowledge is viewed as highly inter-related concepts. These findings were based on students' interpretations of the role of the textbook which was strongly related to the examination process and the role of teachers in conjunction with these two components. The textbook embodied discrete units of knowledge in one form, which formed the basis of memorising and replicating for academic success in examinations.

The Dimension of the Source of Knowledge

This dimension refers to how an individual views the locus of knowledge. At lower levels, an individual views knowledge as originating outside of the self and residing in external authority from which it may be transmitted. This represents a naïve epistemological belief. At higher levels, an individual views knowledge as constructed in interactions with the environment and others. This represents a more sophisticated epistemological belief on the continuum of this dimension.

Epistemological Interpretations of the Source of Knowledge in High School

The components from Schwab's Model that informed the epistemological interpretations of the simplicity of knowledge were primarily the role of the teacher and the textbooks in conjunction with this role. Students' descriptions of their high school environment were analysed as an educational setting in which they viewed the locus of knowledge as originating from outside their selves and residing in the authority of their teachers who transmitted knowledge to them through the textbook.

Role of the Teacher

Students reflected on how they were taught in high school compared with medical school. This resulted from the naïve beliefs held by students that knowledge originated in the authority of teachers. Their teachers at high school told them everything they needed to know and students

expressed frustration at not having a teacher at medical school to play this same role. David illustrated the difficulties with this role:

> I found it very different from year 12, actually from the whole school environment really. Here we're pretty much *teaching ourselves* whereas at school it was all *taught to us*. So from that I've found it pretty difficult to adjust to. I was pretty well lost. (David, Intv.1, p.1, L.4)

Many students described a sense of disorientation and loss when adjusting from the traditional role of teachers in high school to the role of tutors in medical school. Students' previous concepts of the high school teacher as the source of authority and knowledge were in contrast to the tutors' roles as facilitators of knowledge. This created disequilibrium, as the students had become accustomed to the practices in high school. Many students reacted angrily, blaming individual tutors for not teaching them. Cameron struggled with this change in role:

> I feel like now I'm having to be *the teacher* and not just *the student* where I would be taught directly what I have to learn so I'm having to go back and teach myself everything as opposed to being taught by other people. (Cameron, Intv.1, p.1, L.15)

In high school, Cameron had experienced being taught by others and this formed his view of the source of knowledge residing in others. Similarly, Brita cited the expectation that knowledge would be transmitted to her:

> It was completely different [in medical school] from high school because I think I was in a sheltered environment where they would basically tell me exactly what I needed to know about everything and so that wasn't really an issue, knowing what I needed to know about something. (Brita, Intv.1, p.2, L.23)

Brita described her high school as a "sheltered environment". This suggests a protective learning environment and may explain the sense of loss experienced by students, especially when they perceived their teacher was pivotal to them. This reinforces the major role that teachers played as the source of knowledge as interpreted by these students. By comparison, Jordan presents the opposite view of his experience of not having a teacher as the main source of knowledge:

> Rather than just sitting in lectures all day and being *fed information by teachers*, which is exactly what it was like at school, I thought it would be a lot more successful for me personally to engage in this type of learning and it would motivate me to do the work. For me personally, I didn't really find any problems with it. (Jordan, Intv.1, p.2, L.28)

Summary of Source of Knowledge

Students viewed the source of knowledge as originating from their high school teacher, who transmitted knowledge to them through their teaching practice based on the textbook. This represents a naïve epistemological belief of this dimension. There was no evidence from these

students of the sophisticated level in high school, which views knowledge as being constructed in interaction with others. These findings were based on students' interpretations of the pivotal role of their high school teachers and the 'sheltered' learning environment they created.

The Dimension of the Justification of Knowledge

This dimension refers to how individuals evaluate knowledge. At the lower levels, individuals may justify beliefs from observation of others or on the basis of authority or on what feels right for them. Knowledge for these individuals requires no justification and this represents a naïve epistemological belief. At higher levels, individuals are able to evaluate evidence in context and substantiate, justify, and critically evaluate this knowledge; this represents a more sophisticated epistemological belief.

Epistemological Interpretations of the Justification of Knowledge in High School

The components from Schwab's Model that informed the epistemological interpretations of the Justification of Knowledge were primarily the examination processes and the role of the teachers and textbooks in conjunction with these components. Students described high school as an educational environment where they were not required to evaluate knowledge for themselves and justify these beliefs. This was as an outcome of the authority and expertise integral to the roles of their teachers. In addition, students described receiving regular feedback on their academic performance from tests and examinations. Therefore, the students were not required to evaluate their own knowledge and justify these beliefs in the context of their high school experience.

Role of the Teachers, Textbooks and Examinations.

The roles of the teachers, textbooks and examinations are inter-twined in the dimension of Justification of Knowledge. These components led students to interpret knowledge in high school as not subject to justification and evaluation. The authority of the teacher and their expertise was never doubted by these students. Neither were they required to evaluate the knowledge contained within the textbook prescribed by their teachers.

Students described having one set textbook per subject which formed the basis of examinations and tests. They depended on the regularity of these texts, based on the specific content, and on the feedback they received in numeric terms. This was in contrast to the medical school, where students received either a pass or fail grade (as the medical program used a pass/fail grading system). As a consequence of their high school education, students experienced frustration and difficulty with the new approach to learning and the transition to problem-based learning in the medical school. In the medical school, students were introduced to the responsibility for

evaluating their own knowledge and justifying this knowledge, which was, for many students, the first time they had experienced this expectation in a learning environment.

The frustration and difficulty of having to evaluate his own knowledge early on in medical school is articulated by Jordan:

> You can't just rely on how well you do in a test or an essay because all you have got is a pass basically and so you need to really gauge how well you're actually going *by yourself* rather than what anyone tells you. (Jordan, Intv.2, p.15, L.20) When you start here you just throw that whole idea of somebody else assessing you out the window really. (Jordan, Intv.2, p.16, L.15)

Jordan was used to having someone else tell him how he was performing rather than evaluating and justifying his own knowledge. The transition to the responsibility for evaluating one's own knowledge provoked emotional responses. Many students cited missing the benefits of regular tests in high school, which sometimes were found to be painful, but were preferred to feelings of uncertainty of evaluating independently. Brita exemplified this:

> I learned things in high school using little tests and stuff that we had in class. I miss tests! I really do! At the time they were painful but now I miss them because I know that they were helpful just to reinforce what you knew and get some feedback about whether you'd missed the point or not and it's more reassuring than just going along by yourself feeling uncertain. (Brita, Intv.1, p.2, L.5)

Brita's feeling of uncertainty is related to her acculturation in high school. This substantiates the argument that high school represented an environment where students were not required to evaluate their own knowledge. Furthermore, for most students, the transition from high school to medical school signified moving from safe and familiar learning and teaching practices, where they were told what they needed to know, to the unfamiliarity of medical school, where they had to find the knowledge for themselves. The prospect of finding knowledge for themselves in medical school provoked a sense of frustration in some students. Brita illustrated these sentiments:

> I found that going to school I wouldn't really have to worry about actually finding - going and researching - it just didn't occur to the same degree. It was more practicing what I'd learnt, whereas here - [medical school] - *no one is going to tell me what I need to know! (*Brita, Intv.1, p.2, L.27)

There are two separate but related issues that resulted from students' previous learning environment in high school. Firstly, as previously stated, the students were not required to evaluate one's own knowledge and justify these beliefs in that environment. Secondly, a pattern emerged in relation to their academic ability in medical school stemming from past performance in high school. Jamie illustrates this: "I took it for granted that I would be okay because I always had been okay in the past" (Jamie, Intv.1, p.2, L.14). When Jamie subsequently failed all her mid-

year first-year exams, she was shocked as this was not within her realm of possibility. Most students assumed this belief.

This finding is that these assumptions were not based on their ability to justify and evaluate their knowledge in high school. Rather, the learning and teaching practices in high school were not sufficiently sophisticated to require them to justify and evaluate their own knowledge. The reports from these students regarding the "effortlessness" of learning in high school, is evidence of this position. Beth illustrates this well: "I guess it's all throughout my whole school career… I found I often did well without a lot of effort" (Beth, Intv.2, p.10, L.27). This effortlessness was supported by Cameron who, in the context of describing his struggles with medical school, announced in frustration: "It was quite a shock because I'm expected – like all through high school was just a breeze. I could hand up anything and get an A for it" (Cameron, Intv.1, p.3, L.8).

Students' lack of experience in evaluating their own knowledge in medical school is a consequence of the system they described in high school of being tested regularly and provided with the correct answers to these tests. Students frequently complained about the absence of answers to previous medical school examinations in comparison to what they received in high school. This was highlighted by Marilyn:

> At school I would use practice exams, so I know what I have to know, and I used tests that the teacher had given us for practice questions, but I can't do that now. I guess there are some previous exams available here [medical school)... *but not with answers!* (Marilyn, Intv.2, p.1, L.12)

These complaints suggest dissatisfaction with the process of having to justify and evaluate knowledge for themselves, rather than being provided with a set of concrete answers to everything. Stemming from this was the inability of some students to evaluate the relevance of knowledge. As expressed by Reese:

> I often find it really hard to kind of distinguish between what is necessary, what's unnecessary. I find that I can spend hours and hours doing something so finicky and small and be completely caught up in that and then realise it's not even relevant at all! (Reese, Intv.1, p.2, L.32)

The absence of experience in justifying and evaluating one's own knowledge in high school contributed to the inability of students to justify and evaluate the relevance of knowledge in medical school.

Summary of Justification of Knowledge

Students described an environment in which they were *not* required to evaluate their own knowledge and this belief was framed by the authority and expertise of their high school teachers. This represents a naïve epistemological belief of this dimension. There was no evidence from high school of a requirement for a sophisticated level, where students were required to critically

evaluate evidence and justify knowledge for themselves. These findings were based on students' interpretations of the process of examinations and receiving feedback which they relied upon for justification, as they were unable to evaluate their own performance.

Chapter Summary

This chapter has identified and described the components of the learning and teaching practices of epistemological significance in high school that informed the analysis, reported the results of the analysis based on the four dimensions of personal epistemological theory, and summarised students' interpretations of learning and teaching practices in high school.

The learning and teaching practices of epistemological significance identified from Schwab's educational framework were:

- The Teacher: Viewed as a designated teacher for each subject with content expertise.
- The Learner: Viewed as teacher-directed, learned individually, examined regularly.
- The Subject Matter: Individual subjects with a set text and a defined syllabus textbook.
- The Learning Environment: Primarily classroom based.

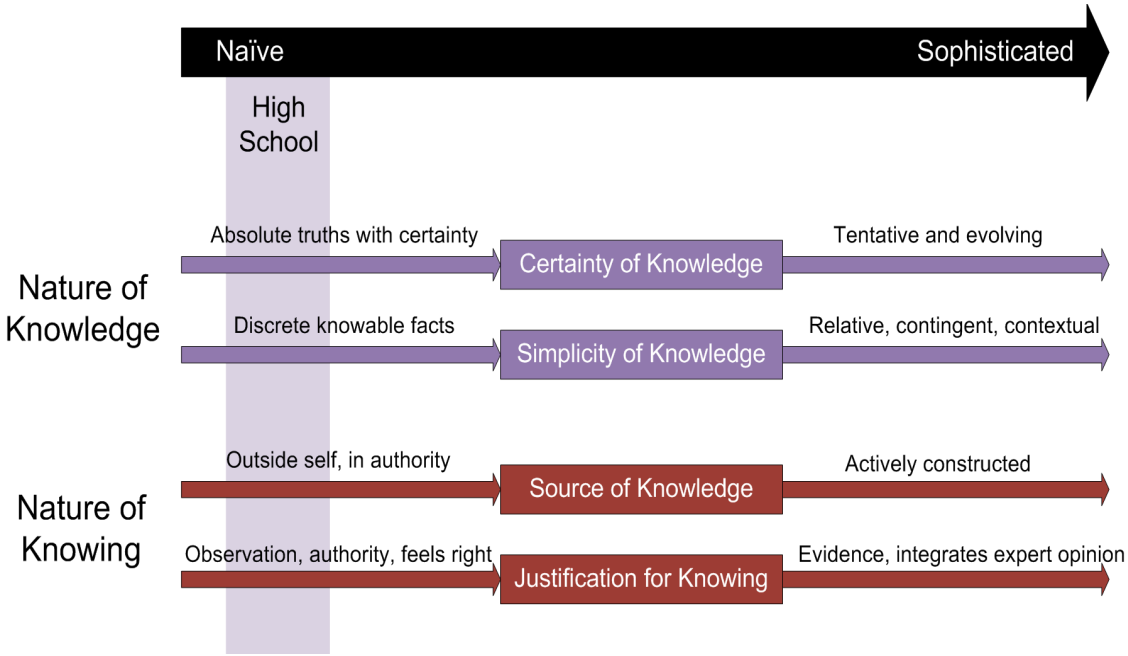

Figure 2 Dimensions of Personal Epistemology Representative of High School

The analysis of students' descriptions of knowledge in high school showed evidence of all four dimensions of personal epistemology: certainty of knowledge, simplicity of knowledge, source of knowledge, and justification of knowing. The analysis confirmed students' beliefs about

knowledge in high school were naïve beliefs representative of the lower level of the dimensions of personal epistemology. This is shown in Figure 2 (page 97). The shaded portion diagrammatically depicts students' beliefs about the nature of knowledge and knowing in high school.

To further illustrate the significance of these findings, the epistemological beliefs these students expressed regarding high school are representative of the lowest position/stage/perspectives of each of the four models of epistemological development. These are reproduced in brief:

Perry's Scheme: Right answer exists for everything exists in the absolute; known to authority whose role is to teach them.

Women's Ways of Knowing: Women assumed they can receive and reproduce knowledge that has been handed to them from authority. They cannot generate knowledge themselves.

Epistemological Reflections Model: Absolute knowers view knowledge as certain and believe authorities have all the answers.

Reflection Judgment Model: Knowledge is assumed to exist absolutely and concretely and can be obtained with certainty, and beliefs need no justification.

There was no evidence that the learning and teaching practices the students encountered in high school required sophisticated epistemological beliefs. To the contrary, most students described high school as easy and requiring little effort.

CHAPTER 6: EPISTEMOLOGICAL VIEWS OF MEDICAL SCHOOL

Introduction

The chapter initially identifies the components of the learning and teaching practices in medical school of epistemological significance which informed the analysis. Following this are the defining characteristics of problem-based learning (PBL) provided by an expert in that field. Together, these illustrate the substantially more complex learning environment of medical school in comparison with high school. This is followed by an epistemological analysis of students' interpretations of learning according to the theoretical framework of the dimensions of personal epistemology (Hofer & Pintrich, 1997). The final section outlines the spectrum of epistemological views held by medical students shown on a continuum from naïve to sophisticated beliefs.

Results from Schwab's Educational Framework

The content analysis of the components of the curriculum, educational resources, and the learning environment was reorganised into Schwab's educational framework. These are listed below according to the four commonplaces: The Teacher, The Learner, Subject Matter, and Learning Environment.

- The Teacher: Primarily the PBL tutor in the role as facilitator of the PBL process. Tutors have either science or medical backgrounds, but would not be content experts in all areas associated with PBL cases. The tutors and tutor groups are rotated each semester.
- The Learner: Viewed as student-directed and collaborative learning within a PBL group.
- Subject Matter: Integrated subjects delivered through written PBL cases accompanied by PBL sheets, lecture materials, web-based resources provided by the medical school, resource sheets for laboratory sessions, and PBL case-wrap lectures.
- Learning Environment: The main learning environment is PBL tutorial rooms. The others include lecture theatres, clinical skills laboratories, and hospital placements. In this study, the learning environment extends beyond the physical learning environment to encompass the process of PBL.

The PBL tutorial rooms are purposely designed to facilitate the PBL process. This process consists of working through a different PBL case each week in a PBL tutorial group of between 7-9 medical students each. There are four PBL tutorials to each PBL case, with a tutorial session held every second day. Tutorials are approximately two hours in duration and the PBL case is disclosed progressively over these sessions. During each PBL session, students engage collaboratively in the process of hypothesis building. They collectively identify the learning issues

resulting from each PBL case session. The learning issues form the basis of research and learning between sessions. Students engage in this process individually and contribute their knowledge to the group in the next session. By the end of the four sessions, students are expected to understand the major learning objectives of each PBL case. The lectures and laboratory sessions are designed to support the PBL cases.

Defining Characteristics of Problem-Based-Learning

Problem-Based-Learning (PBL) was originally developed in medical schools to integrate basic science and clinical knowledge (Barrows, 1986). To frame the context of this approach, the defining characteristics of PBL and the cognitive constructivist approach to PBL are reproduced from the article *The Process of Problem-Based Learning: What Works and Why* (Schmidt, Rotgans & Yew, 2011). The authors reviewed 20 years of studies in PBL to "examine what happens to the learner in PBL in order to elucidate the process than unfolds when students try to learn new material through this approach to learning" (p. 793). The characteristics and implementation of PBL may differ across medical schools; however, the defining characteristics are:

(i) Problems are used as a trigger for learning;

(ii) Students collaborate in small groups for part of the time;

(iii) Learning takes place under the guidance of a tutor;

(iv) The curriculum includes a limited number of lectures;

(v) Learning is student-initiated, and

(vi) The curriculum allows ample time for self-study. (p. 273)

In addition, Schmidt et al. (2011) describe the cognitive constructivist approach to PBL derived from cognitive psychology, which emphasises the activation-elaboration hypothesis as follows:

> In PBL, learners are presented with a problem in order to activate their prior knowledge. This prior knowledge is then built upon further as the learners collaborate in small groups to construct a theory or proposed mental model to explain the problems in terms of its underlying causal structure. As learners continue to study related resources, their initial mental model is further modified and refined. Moreover, as the learners' preconceptions are activated, they become more easily able to identify gaps in their prior knowledge, thus enabling better learning to take place (the activation-elaboration hypothesis). (Schmidt et al., 2011, p. 793)

Personal Epistemological Theory Applied to Medical School

The epistemological analysis in this chapter reports on students' reflections of their first two years in medical school. The students reflect on their initial learning experiences followed by their adaptation to the learning environment of the medical school over this period. The preceding chapter took a collective approach to presenting the analysis. Thereby, students' interpretations of high school were reported and described according to the four dimensions of personal epistemological theory: the certainty and simplicity of knowledge, and the source and justification of knowing. The rationale was to methodically embed the theoretical concepts of epistemology and illustrate these dimensions in a traditional educational environment. Together, these aspects facilitate understanding and interpretation of epistemological theory discussed in this chapter focused on learning in the first two years of the medical program. The nature of the academic tasks and the problem-based learning (PBL) medical school environment are substantially more complex than high school.

To illustrate this complexity, the analysis took an individual case study approach (Merriam, 1998). The results are presented as a series of eight narratives constructed from each student's experience. The methodology of the construction of the narratives was outlined in the research design in Chapter 3. The stories of David, Gordon, Cameron, Bailey, Jamie, Reese, Beth and Catherine are presented sequentially, followed by an epistemological analysis of each. As outlined previously, these students were purposely selected to illustrate the range, variation, depth and breadth of epistemological views of the total number of students in the study. The first narrative is from David. It is titled "You Just Pick Things Up!" which is a quote from David's interview that was analysed to reflect a particular theme from his experience. The narratives from the other students are listed below, accompanied by their respective titles.

Gordon	Baptism by fire
Cameron	I've come this far I must be doing something right
Bailey	I've always been independent
Jamie	I took it for granted that I would be okay
Reese	A year and a half of hating PBL
Catherine	The others were just taking what I said as Gospel
Beth	I really know where I'm at

David: You just pick things up!

I pretty much knew nothing back in first year about any of the cases so basically it was just getting an idea of the organ systems just to start off with and how they work and then from there go looking at the pathology of that. I was pretty lost. I had no idea where to go. I went pretty much with what other people had gone in and gone according to that and it pretty much comes down to your tutor as well, how guiding they are in terms of the way you do it. It took me the first couple of cases to get used to it but after that I pretty well adjusted to it, so you just sort of pick up what you have to do and just get a feeling for what the objectives are and that sort of thing.

I don't know how I adjusted actually. If it's something I don't know about basically start off with very basics and then work my way around from there and try to explain things, just comparing what's going wrong to what they actually want and basically by now I know what they actually want from us in terms of very early on in the case to perhaps management or investigation and things like that so I think once you get on to some basic structure of where to go then it's okay but first year was very difficult finding out what they actually wanted us to know and how far they wanted us to go. I used to be able to study by myself, no worries, and then when I was in a group [PBL] I didn't really find it that constructive but in High School you actually have the syllabus saying what you need to know, whereas with Med it's very, very, very broad, which has been one of the problems so you have to work in groups always.

Right from the start it's really good to look at dominant members in your PBL group. You find that some people have just a natural ability to know what to do and I think you definitely look to them. You can generally tell the people that really know what they're doing. They might not even say it but, yes, they know what they're doing and I generally assess [myself] off them. It'd make things a lot harder if it wasn't a PBL situation. I think one reason why I tend to look at other people is because we're in the PBL group and the small group sort of situation, whereas with at school it's just what the teacher has actually lectured us on that day, looking at how well I understood that.

If you're in a group that does a lot of work I think it's easier because you can look at what they're saying and seeing if you've gone through that and see if you need to learn about some more things in comparison to what they've gone through. It definitely makes a difference what group you are in. You pick a lot of things up off other people as well. I focus on what the group has done - I think it gives you a better idea. . What the group comes up with is more focused than what I do. I do what I do and plus what the group does as well. Basically it just comes down to where the group's gone.

The big difference is in what tutor you have as well. I think the tutors are very important and also looking at what my friends were doing and what they were going into, whatever else in the group and I think pretty much - I think we all pretty much came up with similar learning issues and from there we used them to guide us as to where to go Personally I want a tutor who's actually more guiding and lets us know how much we have to know about certain things whereas if we've got tutors that - well so far I've

been lucky in that way. I haven't had tutors that have just sat back and said nothing so that's okay.

You just stumble across things in doing your reading and they sort of point you in the right direction. Basically it just comes down to where the group's gone. I think probably for me the most important thing is being in the group, sitting around and brainstorming coming up with ideas and then you go off from there. When I've got a good group basically you're sort of really pushed to do more work to keep up with everyone else. If you're in a passive group then I think - I don't think there's anything sort of guiding you as to what to do. It's quite hard to work it out yourself; you definitely need the help of the group and the tutor as well. We've been doing our group objectives and the tutors have chipped in what we should know and talk about and sometimes we miss objectives, so yes, definitely the tutor and then what the group does as well.

Now, I've got a pretty decent sense, I think, of what's going on, what I need to know more of. I've just developed that probably more over this year, more than last year, but I think when you're looking at everything, especially before the exams, you look through things. You're like "I really don't know enough about that, I should go over it". You pick things up yourself that you know you should go over a bit more. I worked really, really hard last semester, especially in the group that we had. We worked really well together. It'll probably be a lot harder this semester because we have to cover the whole year's work.

Towards the exam we all study together [my friends] and we'll compare what each other's group went through and we ask "Did you look in to this" and that sort of thing. We cover, say, a case a day, and basically talk through the case. We go through the case notes and talk about the pathophysiology, investigations etc. This is important because I think you tend to miss a few things. Then generally you find things that one group didn't focus on and other groups did. It's a gamble as to whether you do go through that. Before that you don't really find out until the end that you have missed things. You can look at the objectives. You can look at what you've done in PBL, but yes, it really comes down to other people as well. For me that's been one of the most important things.

David: Epistemological Analysis

Certainty of Knowledge

David demonstrates that he is on the naïve (lower) level of this dimension. He views knowledge as being of a fixed and not fluid nature. He interprets knowledge in the medical program to be absolute and certain. This is shown by David's description of the PBL process and system of preparing for exams. For example, David meets with friends before exams and works through the learning issues that they have combined from all groups. He learns these as a system of covering all the learning issues and cites that otherwise "it's a gamble" as to whether these were covered.

David reflected on the syllabus in high school, which told him what he needed to know and describes knowing what he needs to know in medical school as being “a problem”. To counteract this, David seems to be replicating his past learning practices of rote learning the contents of the textbook. This affirmed his view of the fixed nature of knowledge, as the book contained all the concrete knowledge he needed to know.

Simplicity of Knowledge

David demonstrates that he is on the naïve level of this dimension. David views knowledge as being an accumulation of isolated facts and, therefore, not highly inter-related concepts. After two years in medical school, he still views knowledge as facts that can be learnt in isolation. As an example, when David was describing how he learns, he frequently referred to “you just pick things up”. This term also signifies the accumulation of isolated facts. Throughout David’s interviews, he was unable to elaborate on this process of picking things up. This shows he was unable to view knowledge as highly related concepts.

Source of Knowledge

David demonstrates that he is on the naïve level of this dimension. David views knowledge as originating outside his self and residing in external authority from whom it may be transmitted and, therefore, not as knowledge construction for himself in interaction with the environment and others.

The authority David refers to is the medical school and his PBL tutors. David heavily relies on the transmission of knowledge from these sources. He is also heavily influenced by the authority of other students in his PBL group. David illustrates that knowledge resides in that authority of medical school with his proclamation that, after two years in medical school, “now I know what they actually want from us!”

However, the component in the learning environment of most epistemological significance was the role that David attributed to his PBL tutor and his role within the PBL group. In relation to the authority of the PBL tutors, he advocates the importance of the role of the tutor in providing a high level of guidance. With respect to his role and those of other students, David advises “right from the start it’s really good to look at the dominant members in your PBL group”. David appears to accept the authority of these students without questioning this basis, citing: “some people have just a natural ability to know what to do”. This further shows that David does not construct knowledge for himself in interaction with others and the PBL environment. David does not demonstrate that he takes a role in construction of his knowledge at an individual level and, instead, describes his reliance on the authority of the PBL group in saying that it “just comes down to where the group's gone”. David was unable to articulate how he constructs knowledge

for himself in these interviews, stating frequently "you just pick things up". Furthermore, David's responses to interview questions in relation to his learning process as an individual were frequently answered with a collective response starting with the phrase "what we did". His focus was always on what "we learnt as a group". This illustrates David was unable to construct knowledge for himself and looked to the authority of the group learning process.

Justification of Knowledge

David demonstrates that he is on the naïve level of this dimension. David justifies his beliefs from the observation of others, on authority, and on the basis of what feels right. Knowledge at this level requires no justification. He is unable to evaluate evidence in context and substantiate these beliefs. For example, right from the beginning of medical school, David relied on the observation of other students, other tutorial groups, and his tutors. In relation to justifying his knowledge, he openly admits "I don't know how I do that actually. You just stumble across things". This indicates David does not engage in justification of knowledge.

The role of the PBL group plays a substantial role in this category for David. He defers to the group process and their collective output as the defining authority and does not evaluate this knowledge for himself. This was referred to in the Source of Knowledge. It is relevant in this category also, as David did not question this source of knowledge and, therefore, did not examine the evidence in context. He based it on the over-riding authority of the group.

Lastly, to substantiate David's views of justifying knowledge on the basis of what feels right, as opposed to evaluating evidence in context, David reiterated: "You just sort of pick up what you have to do and just get a feeling for what the objectives are and that sort of thing".

David: Summary

There was evidence of all four dimensions of personal epistemology within David's description of learning in medical school. David is towards the naïve level of these dimensions. David's epistemological views have not altered over the first two years of medical school. The components in the learning environment of most epistemological significance to David were: the role of the PBL group, PBL tutors and, to a lesser degree, his peers. David appears to have misinterpreted those key roles based on his misinterpretations of the process of the problem-based curriculum. These interpretations were contrary to the learning and teaching practices intended in the design and implementation of the PBL curriculum.

Gordon: Baptism by Fire!

I was very lucky I moved into [residential] college last year and the girl opposite me was a 5th year med student so the first cases I go around there: "I don't know what I need to learn, teach me, give me the references give me the blah, blah, blah" and I really appreciated it because she didn't say go learn this process or learn that kind of mechanism. She was more - well this is the process - and gave me a method of how to learn things: Like if a patient presents with this else could it be possibly be and look around. That kind of differential diagnosis kind of stuff and then what do you need to know in order to explain these kinds of things. So sort of learning a normal process and how that can trigger off things. Before I didn't know what to expect or what standard was required so I almost sort of gave up. That's why I really enjoy med school because I was learning for learning's sake and learning because I enjoyed it and it was a hard transition because I didn't know what to do or where to look.

I didn't need people to tell me what to do. Once I'd found my feet and got through the initial cramming - it wasn't until after the first mid-year exams that I was really getting into the flow and a patient presents with this and I'd know where to go. Then I could start taking hold of things myself and I didn't need people to tell me what to do. Every now and then I do slip up but I was able to take charge myself. So my whole process of learning changed quite dramatically and it's for the better as before I didn't really realise that this is what I really wanted to do but coming here now and seeing how it all works and integrating that with clinical stuff I can see where I'm going.

I've made the right decision. I remember speaking to a 5th year and I'm like "When did you get PBL? This is shitting me, I hate it. I seriously think I'm going to fail these exams. I can do resource because I can learn rote ways, I can learn like the muscles, and when I come to the exam, they're like little flags, memorised it out of the book. I don't know what's going to happen to get through this and answer questions". And he was like just learn it yourself and if you can, explain to me how you get through the process. So this happened halfway through first year, and it was really funny because when I came back after the mid-year break after studying for the exams I was feeling good; I was like Yeah, this is cool, I've made the right decision.

Sometimes it was all this whole melodrama of PBL " I don't understand - this is crap, blah, blah, blah - I need to be told what to do". That really irritated me. So I think I had to find it in myself. I remember I sat down one night and just read some massive chapter on something and I was like this is not working, I cannot memorise any of that and I don't have any connection. I had a couple of PBL sessions and it sort of got the ball rolling and from there it was like I can see how this works now. It was almost like, sort of baptism by fire and sort of trial and error, that kind of thing, and I sort of got it from there and more or less just stumbled into the flow and then sort of saw how it works. It wasn't easy and never did I say you can piss off' but sometimes I got fed up and I'd like a little direction sometimes. But where I see where I am now it's a lot better and I really enjoy PBL. Although the [admissions] interview is supposed to weed out people that all they do is sit and stare at books. There's nothing more that I

hate than the post exam talk and everyone stands there and says “I get PBL and I studied until 4 in the morning”. Well, if you studied until 4 in the morning I don't think you were being very efficient!

It takes confidence in yourself! I remember our first case was a patient presenting with chest pain and someone puts their hand up and goes pericarditis and it's like, yeah, pericarditis, what's the deal with that, but as someone just stepping out of year 12, three months of summer holidays and walking into a room and someone said pericarditis you think “Shit what the hell's going on. I thought I've got to know that. What does that mean? Can you repeat that word? How do you spell it”? That was really off-putting but like - they're repeating for a reason – so I was like “take it easy and learn your own way”. So I had to really be conscious of not following other people who said “I did this and I studied until 5 in the morning blah, blah, blah” and it takes a lot of confidence in yourself. I found there was no point in me going, you know, beating my chest to other people and saying “This is what I'm doing”. I had to be confident myself that when I walked into the exam I was happy that I'd learnt as much as I could or I had an appreciation as much as I did, rather than being able to say “I studied so many hours” and all this kind of stuff. I said “Well I didn't do that but I have an appreciation of what I learnt and if you give me something I can explain that”.

Sort of waterfall cascade came at me. Early on we had a case where the patient had sharp chest pain and I remembered the pericarditis so I grabbed a specialised book on cardiology. I opened it to pericarditis; it had a good 40 or 50 pages on it and I sat there and took notes on those 40 to 50 pages and then I went to the PBL session the next day and I realised that I had nothing …I had nothing to contribute. I was like there are a zillion causes for it. I don't even remember any of what I learnt that night. It just helped me not at all! It was just crap and I'm just “this is just stupid, what am I doing”? So I went and spoke to the tutor and said “What am I doing wrong”? and she's like you’re trying to fight this PBL system and memorising the stuff that had no connection with it. So I stood back and I was like “Okay, what causes the sharp chest pain, what are the causes for it and how do those things work” and so I looked into those things. So when I started seeing this interconnection of seeing - like these notes - sort of waterfall cascade come at me. That really made a difference. And again, I had to tap myself on the shoulder and remind myself of that because it's easy to get carried away with the big words and the numbers and that all kind of stuff. And sure you need to know that but without the detail it's just wishy-washy. So you do need to interact with the detail but you also need to find that fine balance from all that kind of stuff. So yeah, it was really good. So as I was going along, learning about the whole PBL process, I was learning by trial and error “that doesn't work; won't go in”. Like I said, I read that massive chapter that night “ that didn't work, stupid, don't do that again; how about you read some clinical things and do some work from there”. So it was sort of like a one-on-one thing in terms of evaluating myself.

Gordon: Epistemological Analysis

Certainty of Knowledge

Gordon demonstrates that he is on the sophisticated (higher) level of this dimension. He views knowledge as being of a fluid nature and not of a fixed nature. Gordon vividly described struggling with learning early on in medical school. He initially attributed this to his own failure to replicate his methods of learning proven from high school. These consisted of rote learning what he called massive amounts of material, and this worked because of the fixed nature of knowledge. Gordon described the process of learning by trial and error in the context of realising that knowledge was evolving and modified in exchange with others and the environment. This was reflected in his example of trying to learn from the pericarditis textbook, using methods of learning from high school, and then realising this approach was unsuccessful as he had nothing to contribute and modify in exchange with others in his PBL environment. Gordon experienced a fundamental shift from his previous beliefs because of the fluidity of knowledge in medical school.

Simplicity of Knowledge

Gordon demonstrates that he is on the sophisticated level of this dimension. He views knowledge as highly inter-related concepts and not as an accumulation of facts. Gordon progressed from memorising facts that he had no connection with to seeing the connectiveness in context. This is shown by his description of the pericarditis scenario. Following this unsuccessful learning episode, he sought advice and was told he was fighting the PBL process by memorising and accumulating facts. Once again, Gordon struggled with this after what he termed a baptism by fire realised the inter-connectiveness of knowledge through the PBL process. He vividly likened this realisation as a waterfall cascade of inter-connected notes.

Source of Knowledge

Gordon demonstrates that he is on the sophisticated level of this dimension. Gordon views knowledge as being constructed by himself in interaction with the environment and others. Gordon has developed into what Perry (1970) described as "the person, previously a holder of meaning, becomes a maker of meaning" (p. 87). He does not view knowledge as originating outside of self and residing in external authority.

Gordon clearly articulated his process of learning changed dramatically in medical school. He described his initial need for some direction from PBL tutors and other medical students from higher years. Then he was able to "take charge myself" and progress to where he "didn't need people to tell me what to do". Gordon was irritated and very judgmental of other students that he described as caught up in the "melodrama of PBL" where they had to be told what to do. He

differentiated himself from these and surmised that he "had to find it in myself" within the PBL environment.

Justification of Knowledge

Gordon demonstrates that he is on the sophisticated level of this dimension. He has progressed to evaluating his own knowledge in the context of the PBL learning environment and can substantiate and justify these beliefs. He does not justify his beliefs from the observation of others, or authority, or on the basis of what feel rights. Gordon is able to critically evaluate his own performance in PBL. Just as he is harsh on other students and their complaints about PBL, he is equally harsh on himself. For example, working through the process of evaluating his knowledge, he says to himself "that didn't work, stupid, don't do that again".

Gordon describes other students who "studied until 5 in the morning" and were not confident before going into exams. He stressed he was conscious of "not following other people" and, instead, he strove to "be confident in myself when I walked into the exam". He expressed this process "like a one on one thing in terms of evaluating myself". This shows he has progressed to evaluating his own knowledge in the context of the PBL environment.

Gordon: Summary

There was evidence of all four dimensions of personal epistemology within Gordon's experience of learning in medical school. Gordon is on the sophisticated level of these dimensions. His epistemological views have developed significantly since Gordon began medical school. In addition, Gordon was able to articulate his struggles and elaborate on his learning insights during his progression over the first two years which influenced his epistemological development.

The components in the learning environment that were of the most epistemological significance for Gordon were his role as a learner and the integrated nature of the subject matter in PBL cases. Gordon took responsibility for his role as a learner, and was not affected by the impact of tutors and peers. The integrated subject matter of the PBL cases appears to have fostered his epistemological development. His interpretations of the learning and teaching practices in medical school were aligned with the theoretical basis of PBL.

Cameron: I've come this far I must be doing something right!

I was still under the impression that we don't need to be taught a lot of things. To begin with because I wasn't exactly sure what they meant by self- directed learning. Part of the trouble was finding what to actually cover when we were learning, like having to find the resources ourselves and go back and have a look and read over things and read it again and again. It was pretty tough. To begin with I had no system whatsoever because it was just a lot of trial and error but I've sort of developed a system now where I know where to aim for and what to do but that process has taken quite some time to develop. I tried my high school methods of learning where I was just trying to rote learn everything and read facts and then try and memorise things but I found that didn't work at all so I moved on to try and actually read things and try and develop some understanding about it before I actually tried to look into it because with the course being medical and all that sort of stuff. I had to go back to basics before I could actually tackle things. I called upon my peers to try and get some help, some assistance, and some direction. Through the PBL groups, speaking with people, knowing which areas to cover but still - at the start it was such a broad range of things to cover - like we had no idea! You could tell. Like being first years none of us had any idea really what to cover.

I was still under the impression that it was all like tutor driven and I was going by what my tutor had told me! I didn't have a very good experience with my first PBL tutor and I only found out how I was going at the last minute. I don't think I was very good so that sort of set me back as well. Most tutors give you feedback during the course of the semester - whereas this one just saved it all it up for the report so it was just a bit of a rude shock when you thought okay - I know nothing! In the first semester I thought I was doing okay just - because I hadn't done anything like this before so it was a bit of a shock to my system and because some people take longer than others and I felt I was one of those people. Still would have been nice to actually hear that from someone else during the process rather than myself because as much as you tell yourself you always doubt - well maybe I am doing okay sort of thing.

You're pretty vulnerable and you have no idea what to expect so at least for the first semester you want some sort of direction from those who are tutoring you. I was pretty upset to begin with but I realised that I did have to try a completely different method of learning because it just wasn't working. I found with the second semester the difference was my PBL group. It was really good - our tutor was supportive and telling us constantly like you're heading in the right direction or something like that and it sort of made you realise that you were doing the work properly and it helped with understanding it. So part of it was being in a good group but I also found I just had to go back to basics as opposed to trying to –like because we develop learning issues and you've got to work around those learning issues, don't just answer those questions specifically, like you've got to work around it, go back to basics, learn about normal before you can think of abnormal and, because that's what I wasn't doing in the first semester also.

Now I do more work myself and not just within the group. Now at least I know where I'm heading and I've had good tutors so they've helped to support that - point me in the right direction. I feel like I have been able to work out what I need to know, it's all experience. I guess that through the year I've been able to develop, find out where I've got to go. It involves a lot of work but it's helpful and in the end I actually understand things as opposed to trying to memorise facts. With this group, this semester also, it has sort of been that we don't put everything up on the board so a lot of it you've got to be able to find yourself so you have to do all the work yourself as well. It has made, forced me to actually, do more work too to make sure I'm actually getting all the concepts myself, not just within the group.

Knowing for yourself is really tough because leading up to the exams all the tutor reports come back and a lot of it depends on your tutor and how well they assess you. Like some people are pretty generous with it so you still don't really know - I still don't know how I'm going to go in the exams. I just hope; fingers crossed. Last semester was great, like our tutor really worked towards the exams and told us that we were doing really well and in that sense that was reassuring but, yes, still that unknown, because you still don't know it's a hard one to explain. I think a lot of it is developing methods also yourself to help you study. In that sense I've worked out something which works for me but otherwise you still don't get there. I try to review after each case but I don't do it like in detail. Most of that I just work up towards exams and then cram. I make sure that all the learning objectives that we all comprise - that we've covered everything that's in the case, just to make sure we've got some sort of understanding on those, maybe not in detail I must say but at least know, yes, I've covered that.

I compare myself to a lot of my peers within my PBL group. Also with my friends being in different groups there's a lot of variation between what the tutor and what the group itself considers what they think the important concepts of the case are and how much detail they go into it. Like you get the case objectives, or you work them out, but still you don't know to what extent to cover them and you didn't know if you were doing the right thing. Have I gone into too much detail with this one or is it a minor point and I think just gauging what other people have done - and seeing what they think - is a good standard for that particular objective or the case – it just gives you some idea of have I done enough? Have I done the right thing sort of thing?

Sometimes you think oh no I've completely done the wrong thing and it puts you under a bit of pressure so in some ways it can work against you because people will go this is the main point. So I'm like I haven't done that much so it's a bit worrying. Then again they might be wrong. So a lot of it you've just got to think for yourself - is it really that important? So, just gathering what they have told me and what they think are the important concepts and yes I just have a think about it and was it necessary for me to learn that.

I'm not like the others. I'm not a very good student- I'm not going to go out and learn about it straight away if I haven't learnt about it during the case. Like….the other students do all the learning - not me. I'm not like the others - don't know - I think I just do things differently. I know a couple of my

friends - say it's like a case of 'xyz' they'll panic and make sure they do copious amounts on it. I just sit back and go I didn't learn about that but I don't know if it's relevant' sort of thing so in that way I'm different from them. But, sometimes it can stress you out too - their stress can influence you and I go "Oh, gee, maybe I haven't" but then again I go "no, it's OK". I guess I could say I have enough confidence in myself to know that I don't really have to listen to what they're saying because I think it's unnecessary how much stress they're putting themselves under. Look at the end of the day, particularly with exams and everything, I go "I've come this far so I must be doing something right".

Cameron Epistemological Analysis

Certainty of Knowledge

Cameron demonstrates that he is on the naïve (lower) level of this dimension. Cameron views knowledge as being of a fixed, not of a fluid, nature. Initially he described trying to rote learn everything as he did in high school, and this showed he believed knowledge was fixed and absolute. He then described his new system in medical school where he moved on "to try and develop some understanding", rather than "to try and memorise things" as he had in the past. While Cameron clearly articulated that he understood the PBL process and the learning opportunities within that context, in practice he did not fully engage in this process. For example, he relied heavily on his tutors for direction on what to learn, how much to learn, and expected direct feedback on these requirements. He focused on making sure he had "covered everything" from each case. This suggests that there is a prescribed and fixed amount of knowledge. As a result, he was not able to progress to the higher level of this dimension where knowledge is viewed as fluid and evolving in exchange with others and the environment.

Simplicity of Knowledge

Cameron demonstrates that he is on the naïve level of this dimension. He views knowledge as being an accumulation of isolated facts and, therefore, not highly inter-related concepts. This was demonstrated by his explanation when preparing for medical school examinations. For these examinations, Cameron reverted to his old methods from high school. He described trying to cover all the learning objectives for PBL cases with the help of his peers and friends and then "cram" this information. This demonstrated that Cameron viewed knowledge as comprising of bits of knowledge that can be learnt in isolation from each other, rather than viewing knowledge as highly inter-related concepts. This was contrary to Cameron's previous description of his development from being able to "rote learn everything and read facts to understanding knowledge". When Cameron cites: "Yes, I've covered that" in relation to the detail in the PBL

cases, this reinforces knowledge as an accumulation of facts that can be "covered", rather than as inter-related concepts.

Source of Knowledge

Cameron demonstrates that he is on the naïve level of this dimension. He views knowledge as originating outside his self and residing in external authority from whom it may be transmitted. Therefore, Cameron does not view knowledge as being constructed in interaction with the environment and others. The authority Cameron relies upon most is his PBL tutors.

The importance and authority Cameron placed on the role of his tutors was significant. He constantly sought direction and apportioned blame to one tutor for failing to provide feedback. As a consequence of these circumstances, Cameron perceived that the tutor was to blame for the fact he failed his examinations. A further example of this was his reference to his most recent tutor in second year: "like our tutor really worked towards the exams and told us that we were doing really well". This illustrates that Cameron, even after two years in medical school, expected significant direction and knowledge from his tutor as opposed to constructing knowledge for himself.

Cameron also viewed his peers as an authority who transmitted knowledge gained during the PBL process. He described how instrumental a good group was to his adaptation to medical school after a difficult beginning in Year 1. However, he continued to rely on what other group members provided. For example, he referred to his process of "just gathering what they have told me and what they think are the important concepts" at the end of his second year. Once more, this indicates that he does not view knowledge as being constructed in interaction with others, but rather relies on what "they have told me".

Finally, Cameron's personal disclosure "I'm not like the others. I'm not a very good student - the other students do all the learning - not me" supports this claim that Cameron views knowledge as originating outside his self.

Justification of Knowledge

Cameron demonstrates that he is on the naïve level of this dimension. He justified his beliefs from observation of others, on authority, and on the basis of what felt right for him. Therefore, for Cameron, knowledge required no justification. He was unable to evaluate, substantiate and justify his knowledge in the context of the medical school learning environment. Cameron unconditionally accepted the authority and knowledge of his PBL tutors. He was unable to justify his own level of knowledge. For example, in reference to his expected upcoming exam

performance, he expressed “I just hope; fingers crossed”. This was the belief he held after two years in medical school.

Cameron also referred to the lengths other students went to in evaluating their knowledge, saying “it's unnecessary how much stress they're putting on themselves”. He did not want to be influenced by their stress and yet was unable to justify how he evaluated knowledge for himself. When asked about his own process of evaluation, his response was quite laid-back: “Look at the end of the day, particularly with exams and everything I go I've come this far so I must be doing something right”. This declaration indicates he is not able to evaluate, substantiate and justify knowledge in the context of medical school. Instead, this demonstrates that Cameron is on the lower level of this dimension, which is characterised by what feels right and on observation of others.

Cameron: Summary

There was evidence of all four dimensions of personal epistemology within Cameron’s description of learning in medical school. Cameron demonstrates that he is towards the naïve level of these dimensions, and his epistemological views do not appear to have varied over the first two years of medical school. This is despite Cameron communicating that he progressed from his previous learning experience to understanding the more complex learning process within PBL. The component in the learning environment of most epistemological significance to Cameron was, primarily, the role of his PBL tutors. In particular, the expectations that he placed on each of his tutors to provide knowledge and direction. This was followed by the role of his peers within the PBL process. His interpretations of the role of peers and tutors signified his lack of understanding and engagement in the PBL process.

Bailey: I've always been independent

The way I understand it - the first six years are really just the beginning - and there are a lot of post graduate programs, which have exams which you need to study for, and no-one's going to hold your hand for later. So I guess you need to develop a taste for trying to handle things independently. It says it is self-directed but you do get a lot of help from your colleagues in your PBL groups and there's a lot of direction there. And the medical school does give you a lot of direction in the learning objectives, which you're given each year, so you can see what's expected. It sort of promotes understanding rather than just simple chalk and talk sort of style of teaching and it emphasises the idea that in medicine knowledge is not finite.

Preoccupied with the diagnostic side of medicine: Looking back I don't think I had a great understanding of everything that went on In first semester. There were about six PBL cases, and. In the initial few cases, a lot of us, at least myself and my colleagues, were very preoccupied with the diagnostic side of medicine. So we'd read the cases and think: she's obviously got appendicitis or something like that and so we'd read up about acute appendicitis and just the pathology, the physiology. But we failed to realise that the aim of the case really was to develop an understanding of why abdominal pain arises and the different mechanisms by which it arises and what type of pathology can cause different types of abdominal pain. Whereas a lot of us just went off and read a pathology book about acute appendicitis because it was quite obvious that was the problem.

No finite amount of information that is known in medicine: There's a problem in treating some texts as, sort of the bar, as far as you need to go, and it's dangerous to think that way because it could suggest that there is a finite amount of information out there but there's not. The internal medicine book I use is Harrison's and that's widely known as the gold standard. So the mentality, at least amongst a lot of us, is that if you're reading about say asthma then if you've read and if you understand what's in Harrison then that's as much as you'll ever need. But I think it's a bit dangerous to think that way. I think that when you're in your pre-clinical years you don't realise how quickly medicine updates and outdates itself; and so if you take what's written in your personal favourite internal medicine book as the Bible then I guess it's a dangerous way to study because that's not the way things are in the real world. With constant research going on just therapeutic guidelines change and so you need to keep up to date with that. So if you take comfort in the fact that you know everything that's in a book then it's probably not a great way to be thinking because it really doesn't mean too much in the real world. You've just got to accept that there's no finite amount of information that is known in medicine. There's always going to be something that you don't know.

There's a bit of paranoia around some groups: My PBL groups have ever affected too heavily the way I've gone about things. I think a lot of people base all their work on discussions or objectives that are drawn from their PBL sessions; whereas with my tutorial group I've no problem saying "No, I won't do that one, or that doesn't sound right to me" and then I might read off on other

things. I think a lot of people treat their PBL groups sort of: depth of knowledge as the cut-off, whereas some people might say “My peer group is a bit too sort of diligent for their liking” and they think that a lot of the things that the PBL group would do would be useless. For me, I have never had a PBL group that's gone into a lot of depth over things and I don't think you need to but I've always found that I've gone further than what my PBL group has. I think that in the time we have together, which is about six hours a week together, it's impossible to cover everything that's relevant to the case. So I'm pretty sure that most students would go past what their PBL group has covered. I think there’s a bit of paranoia around some groups. I think they may worry about things that I don’t think are that valid. I don’t think the exams have even been unfair in what they’ve asked from us. It’s not an issue within the way the curriculum has been delivered but more so a personal trait, just a tendency towards uncertainty; whereas a few of the others are quite confident that things are flowing well.

You might be worrying about something that there’s no answer to! I have no fears at the moment that the depth of study and the breadth of topics which I'm going through won't extend far enough to cover me safely for at least the exam period. I've never really had the problem of worrying about whether or not my knowledge would go deep enough to satisfy the examiners. I guess you can gauge it off talking to fellow students in tutes and I guess it's quite easy to see where you sit. It might give you an indication that your depth of knowledge extends further than a majority of the students in your group and it might give you the sort of sense that it will be good enough come exam time, but it doesn't really indicate where the cut-off lies. I think probably because there is no definitive cut-off. And the cut-off is a pretty grey area between black and white so if you try and think where is the cut-off, you might be worrying yourself about something that's there's no answer to.

Guide your own way rather than be guided: When I think of it, if the six hours a week I spent in PBL tutes were spent in the library doing my own work it would probably be more productive. Because out of that two-hour tutorial session, a lot of the time things which are covered are things which you already know. So you may sort of fail to concentrate for three-quarters of that time. A lot of people which I've spoken to have said they never learn anything from their PBL tute and I think, like me, guide their own way rather than taking the guidance of the other members of their group. It depends I guess, on your study mentality and how much you trust your own judgment. I've always been sort of independent about things like this.

Bailey: Epistemological Analysis

Certainty of Knowledge

Bailey is on the sophisticated (higher) level of this dimension, as he views knowledge as being of a fluid nature. Bailey showed this by describing the dangerous practice of thinking all you need to know will be contained in the “gold standard” textbook. In addition, he stressed there is no finite

level of knowledge in medicine. Bailey's example of the constant updating of knowledge and therapeutic guidelines clarifies that he views knowledge as fluid, relative and modified in exchange with the environment. He declares that, in medicine, "there's always going to be something that you don't know".

Simplicity of Knowledge

Bailey views knowledge as highly inter-related concepts and not as an accumulation of facts and this demonstrates that he is on the sophisticated level of this dimension. This was illustrated when he discussed the early PBL cases and his preoccupation of reading up on the facts of appendicitis. He realised that what was required was a more complex understanding of why the pain arose and the different mechanisms to explain this pain. This process reflects the highly inter-related concepts of knowledge, rather than just going to "read a pathology book".

Source of Knowledge

For Bailey, knowledge is viewed as being constructed in interaction with the environment and others and demonstrates that he is on the sophisticated level of this dimension. Bailey does not view knowledge as originating outside his self and residing in external authority.

Bailey acknowledged the role that the PBL curriculum contributed and the direction from the medical school that he received early on in Year 1. This enabled him to construct knowledge for himself in that environment. He refers to "a bit of paranoia" around some PBL groups and refers to students worrying about things as "more so a personal trait" and stresses that "it's not an issue with the way the curriculum has been delivered". In advising others to "trust your own judgment", he sees himself as a constructor of knowledge.

Justification of Knowledge

Bailey demonstrates that he is on the sophisticated level of this dimension. He evaluates his own knowledge in the PBL learning environment and substantiates and justifies these beliefs. He does not justify these from the observation of others or on authority or on the basis of what felt right.

Bailey's demonstrates this by reflecting on the problems he perceives other students have with treating what the PBL group covers as the whole depth and breadth of knowledge. He has never had a problem going beyond what is required for this or saying "No, I won't do that one" in reference to learning objectives. This indicates his ability to substantiate and justifies his beliefs.

In addition, he uses the analogy of fellow students, who take the guidance of the other members of their group rather than guide their own way. He has no hesitation in learning independently of the group and emphasises that he has always been that way and trusts his own judgment. Bailey is also openly critical of the time wasted by some PBL groups going over knowledge which he professes they already know. This indicates he is actively evaluating knowledge in the context of the PBL learning sessions.

Bailey: Summary

There was evidence of all four dimensions of personal epistemology within Bailey's experience. Bailey is on the sophisticated level of these dimensions. There were no single components in the learning environment that were of the most epistemological significance. For example, Bailey was not unduly affected by any components, i.e., PBL tutors, cases, peers, exams. To the contrary, he interpreted the theoretical basis of PBL and the process as intended by the medical school. Bailey proceeded through the first two years of medical school in a very pragmatic manner with no sense of struggle.

Jamie: I took it for granted that I would be okay

I had lots of trouble working out how much I needed to know and how much depth I needed to go into. Lots of other people were in the same sort of situation. We all felt a little bit lost I think. I mean, here, you're the one that has to go and make yourself learn it! Instead of going to a class and have teachers tell you everything and just sit there and listen. It's finding the information yourself and working out what is and what isn't relevant. Just sitting down and making yourself do it, which can be a challenge at times. I wasn't really sure how I was going until I did the exams - I didn't do very well - and I'm like "okay, I haven't been approaching this the right way obviously". I just sort of took it for granted that I would be okay because I always had been okay in the past.

Things just started to fit in together: Second semester - I don't know - things just started to fit in together. I still don't think I'm 100 per cent on top of the PBL process. I think I'm still learning about it. I don't know whether I got along any better because I was more confident with what we were doing or what we were supposed to be doing. I think there was a little bit more direction from the tutor. Like I'd go and do my research, do my learning issues and then get the next sheet, and it would actually be relevant to what I'd read the night before! Whereas in first semester I'd sort of be looking up a lot of stuff, reading a lot of things and then not actually applying them to the cases much. In second semester, like before we went home our PBL group sort of said "Okay, so why are we going to look at each of these learning issues? What is it that we're trying to understand"? I think that helped a lot just too sort of focus what I was reading. Whereas before I was just sort of like "Yes, I read about the physiology of this. Okay: done" and I didn't really apply it to the case as much.

Maybe it was the group: I think it was the group that helped. I think it was the tutor - maybe just practice. I don't know, but definitely phrasing of the learning issues was a lot more precise. It was more obvious what we had to learn whereas before it was just like really broad general and I wasn't really sure how it related to what we were actually supposed to be doing. Whereas here in second semester it just seemed to start fitting together more nicely. I think a lot of people seem to be in the same situation. People were just sort of floundering. Part of it was just a time thing. We were just getting used to adjusting from high school where you're given everything to here where you have to find it all yourself.

I'd sort of think more about what I should be understanding: I think my approach to studying was a little different in second semester. Instead of just having the learning issues and trying to tick them all off - I'd sort of think more about why they were there and what I should be understanding. Then see if I could maybe summarise it or just go through it again in my head afterwards to make sure that I had actually taken in what I was reading. Whereas before I think I was more finding it, writing it down and moving on without actually thinking about it. I still find that I do have trouble working out depth and stuff and talking to other people sometimes helps but sometimes they're as lost as you.

Friends are really useful: It's really useful to talk to friends who were in groups that are going well, especially if you compare notes, because we photocopy all the notes at the end of each session.

Sometimes we'd swap them just to have a look at what other people were doing. So if you were seeing all this stuff that you hadn't even covered then you might go back and say something to your group like "Oh well, I was talking to someone and they said that their group did a lot of stuff on whatever the thing was, do you think that's relevant?" So talking to other people in other groups was helpful. It was not consciously. Like I think it was just because you become really good friends with people in there because you're doing everything together all the time so it would just come up in conversation – " So - what do you think of this case"?

The tutors don't have a lot to tell you: Some tutors give a lot more feedback than others. It's nice to get a report with all ticks on it but it's not really constructive. I guess, you can ask your tutor for more feedback but sometimes they don't have a lot to tell you except "You're all doing fine", which maybe wasn't as reassuring because you weren't sure how much they'd actually thought about it. I don't think they would just say "Oh yes, it's cool, don't worry about it" if there was a serious problem. But, if you are doing okay then I don't think some of them really worry about the difference between doing okay and being good. They sometimes ask a question and try and push you a bit and see where your boundary of knowledge is and having to anticipate what is going to come next. If you can do that I guess that gives you a pretty good idea that you're on the right track.

I guess I'd sort of notice if I was doing okay because I'd see how much other stuff I'd done that week, like how much TV or catching up with friends I'd been able to fit in. I knew that if I'd done lots of things like that and - a lot of just nothing - then I might not have been doing enough work. I sort of felt okay about the mid-year examinations (2nd year) and I did okay, not great but okay. So – yes - I really don't know. I think you do get a feeling as to whether you're going to be okay or not. Like with the prac [practical] exam, you can get an exam like that, that just totally was not what you were expecting at all and just feel shocking about it even though you didn't feel that bad about it beforehand. Like prac has never been my strongest exam because I think there's just too much rote learning. I felt more confident that I knew some of that rote learning stuff this year than I did last year but then when I came out of the exam I was just like " that was bad" but everyone felt the same. Although, I guess I didn't really start my main study until swot vac. I met up with a friend of mine and we summarised some of the cases from first semester, just so that there wouldn't be quite so much to have to cover in swot vac but still, I didn't really start my main study until swat vac started - which was probably silly.

I like the cases I can relate to: Sometimes even just the case makes it harder to read about if you're not interested in it at all. Like, if we get an asthma case -I've got asthma - it seems more applicable because I can relate to it. I'm trying to think of one that I didn't like - I remember complaining about them. Anyway, I like the psycho-social type cases as well. You get to focus on the person rather than just anatomy and stuff and I find it easier to apply it to real sort of situations. Some students just say "Well if they ask it in the exam I'll just make it up". Some of it is common sense but a lot of it you do need to read about and - sometimes just the science of the medicine just gets too much. So the socio-economic stuff it's a nice break.

When it just gets too much: What keeps me going is – well, I've thought about it because we'll do our electives and I won't do any work for them and still get distinctions and that's then I'll do med and not get distinctions, well not that we get distinctions. So you sort of go "well obviously I've got the ability. I've gotten into this course that's hard to get into. I've done the UMAT [Undergraduate Medical Admissions Test]. I've done the [admissions] interviews. I've gotten the TER [Tertiary Entrance Rank] that I needed. I'm doing good in my electives without really having to worry about them too much so there's no reason for me not to be doing well in this course, unless I'm not working enough".

Jamie: Epistemological Analysis

Certainty of Knowledge

Jamie is on the naïve (lower) level of this dimension, as she views knowledge as being of a fixed nature. The epistemological components that formed the basis of this interpretation were the learning issues and examinations.

Although Jamie intermittently described a more sophisticated viewpoint, there was little evidence of this in her actual learning practices. This is illustrated by her interpretation of learning issues. In first year, Jamie was "just looking up a lot of stuff" and "trying to tick them all". She also regularly obtained photocopied learning issues from other groups on "stuff that we hadn't covered". The elements of "stuff not covered" and "ticking off" indicate there is a fixed amount of knowledge. In the mid-year exams in second year, she also described continuing with her process of rote learning and expressed how she was much more confident in rote learning since first year. The practice of continuing to rote-learn for examination in second year suggests Jamie views knowledge as fixed.

Simplicity of Knowledge

Jamie demonstrates that she is on the naïve level of this dimension. She views knowledge as being an accumulation of isolated facts and, therefore, not highly inter-related concepts. As highlighted previously, Jamie sometimes stated a more sophisticated view, which was not shown in the practices she engaged in. For example, Jamie's practice of continuing to photocopy and swap notes in second year demonstrates she still sees knowledge as an accumulation of facts and not as inter-related concepts. The learning issues were, once again, a component which illustrated Jamie's views. Earlier, Jamie described how the PBL group helped her think about "what we're trying to understand" in comparison with previously, when she just read the information and said "Ok – done" without applying this knowledge to the case. The practice of applying knowledge represents a view that knowledge is inter-related. Although Jamie verbalised

this position, her practices suggested she was not able to apply what she had learnt and relate it to the case. Therefore, her analysis indicated she remained at the naïve level.

Source of Knowledge

Jamie views knowledge as originating outside herself and residing in the external authority of others in medical school, particularly her peers, demonstrating she is on the naïve level of this dimension. The component of most epistemological significance was the change in her role as the learner. Jamie described being challenged from the start: "here, you're the one who has to go and make yourself learn". Previously, Jamie relied on the authority and direction of her teachers, while now she struggles with "finding the information yourself" rather than where the "teachers tell you everything". She viewed knowledge as originating from the authority of teachers. However, Jamie did not transfer her reliance on authority to PBL tutors. This was different from other students, who also relied on their school teachers and, as a consequence, blamed PBL tutors for not telling them what they needed to know. Jamie describes her tutors as helpful for feedback but says it is not constructive as "sometimes they don't have a lot to tell you" except "you're all doing fine".

However, Jamie has transferred her reliance on authority to other medical students. In Jamie's extensive interviews, she discussed her dependence on her friendship group within the medical school, and keeping this group was a large motivational factor. She is not able to construct knowledge for herself and relies on the transmission of learning issues from other PBL groups in addition to her own group. Her preparation for exams is based on knowledge from these sources.

Justification of Knowledge

Jamie demonstrates that she is on the naïve level of this dimension. She justifies beliefs from the observation of others, on authority, and on the basis of what feels right and is unable to evaluate and justify her own level of knowledge. She relies on what feels right. For example, she posited "I guess I'd sort of notice if I was doing OK" and relates her level of understanding with opportunities to spend time viewing TV and having social outings with friends. In second semester of first year, she relayed: "I don't know – things just started to fit together". Similarly, prior to the second year exams, she conveyed that "you do get a feeling as to whether you will be okay or not" but expressed being shocked by the exam and her result, which "just totally was not what you were expecting". Lastly, Jamie reflects on her performance and compares her previous academic record with her current one in medical school. She surmises "there's no reason for me not to be doing well in this course unless I am not working enough". However, Jamie demonstrated she is not able to evaluate whether she is working enough. Her dependence on what feels right in the context of medical school is a naïve perspective.

Jamie: Summary

There was evidence of all four dimensions of personal epistemology within Jamie's description of learning in medical school. Jamie is on the naïve level of these dimensions. Her epistemological views have not altered over the first two years. Despite discussing a more sophisticated approach, this was not shown in practice in her overall approach. The components in the learning environment of most epistemological significance to Jamie were examinations, learning issues, the change required of her role as a learner, and her dependence on her peers. Finally, Jamie's disclosure that "sometimes the science of medicine all just gets too much" accurately sums up her naïve epistemological perspective.

A hell of a lot of work but to no end: When I first got here I found it really hard to kind of distinguish between what is necessary and what's unnecessary. I could spend hours and hours doing something so finicky and small and be completely caught up in that and then realise it's not even relevant at all. I found I wasted most of last year doing a lot of work, a hell of a lot of work but to no end. I worked so hard and failed all my mid years! I live at one of the colleges with other med students and the night before our first year exams all 15 of us were up - it was about 4 a.m.- everyone in tears on the phone to their parents "I'm coming home, I'm not going to finish the exam, I'm going to fail". I think the biggest downfall is that there's no concrete gauge for yourself as to know what is enough -and how you are going until exams- and that's why there is panic. Like last year, four people had breakdowns, but it's purely because they don't – we don't – know what is enough!

A year and a half of hating PBL: It's literally taken me a year and a half of being in Med School to finally grasp the concept of PBL and to turn it around and use it as a positive thing. That's been a year and a half of hating PBL and not really understanding why we need to go through all these formalities and the learning issues. So it's from this year that I'm actually having a fresh start and yeah it's really made a difference. But literally, a year and a half to get to that point - that's too long! I mean it's a very bizarre concept! And yeah, just realising from this year, a lot of information is irrelevant. So just kind of focus on pretty much back to basics of physiology, anatomy physiology, pathology and yeah, kind of, more systematic perhaps and realising that you don't need to go into incredible - that's the thing I've realised - you don't need to go into the incredible detail like I thought you needed to. Like every single step, cellular, chemical. So I've struggled a lot with the process and it's just taken me a lot longer to realise exactly what the point of the process is. It's generating hypotheses and things like that and taking a more kind of holistic approach to it instead of just diagnosis! diagnosis! But it's taken me until now to understand how everything ties in together so that you get the clinical thing; and just now I've been able to relate what we do in the group to what we do on our clinical days in the hospital and use both of those things as more of a guide as to what I need to go home and study privately myself. I just realised now it's all interconnecting.

Most annoying are the dominant people in the group: It's a limitation especially with the PBL group and tutor feedback; that if you're a shy person or not comfortable with the group you're in then– and this does happen a lot – especially if there is a dominant group member. Tutors think that shyness equals poorly prepared; haven't put the effort in; haven't done the work; if you're not speaking then obviously you haven't done the work. And it's really tragic. I mean, it's common knowledge if you haven't done your learning issues you just have to say one really profound thing at the beginning, even just suggesting a way we could approach summarising the learning issues, as long as you've said your one thing they can tick you off that you've vocalised something and that's it. It seems to be more in a quantity thing rather than quality. Just the setup that talking equals knowledge. I think that's a bit of a

vicious cycle then. Because everyone has their different roles within the group. There's definitely the stronger people and the quieter people and the type that jump between. The thing that's most annoying is the dominant people, just because they've got the authority perhaps in the way they speak, if they speak with confidence, nobody questions their content. Looking back over some of my notes now there are mistakes and things we just wouldn't have questioned because you just almost assume the people who put them up would know must be correct. So depending on who's in a group, that really alters the functioning.

It's tough to stand up there and do your thing: Often the tutors favour a little the people that speak - and sometimes it's the people that say the least - that might actually know or have done the most. It's not the easiest for them to stand up and I mean it is intimidating; it is! Especially considering the different students and different backgrounds and different attitudes. Not everyone is compatible in the groups. It's tough to stand up there and do your thing when you know you're just kind of thinking we have got eight people sitting back, they must be criticising me. Our group, this time around, there are probably two fairly dominant people and I think that's a huge downfall with the PBL process. If you've got one or two dominant people in the group then that just makes that all the more harder. Because I get really shy in those group situations. That's just my personal thing,

When things aren't rolling along in the group: There's a lot of imbalance in the groups especially when you're with a tutor that the group doesn't seem to function very well with. Last semester, this happened. So if the sessions don't go well; if the group isn't quite compatible then it does mean that you have to take all of that, and do at home, what you should have done in the group. Last semester I had to borrow friends' PBL group notes, people from other groups, and copy out all their mechanisms and all their learning issues. And literally do the entire case again from the beginning, over the weekend. It was just a huge extra load of work to do, but it had to be done. That tutor last semester he wouldn't have known anything about me or my learning. The tutors have their favourite students which are the ones that put forth all the time and that isn't necessarily a reflection on knowledge levels. Louder students are not necessarily most competent, if that makes sense.

Sometimes it goes over your head and you think Uh-Oh: A really good indication of how well I've understood a case is the case wrap-up session at the end of the case where they usually get the specialist on the subject to just talk about main issues in the case and go through the physiology, pathology. Often I'll use that to see if I should have done more. I find that fairly useful, because that's generic, that's the same for everybody, so you could assume that that's what the MEU, I suppose, wants you to know, minus the variability of PBL groups. Sometimes if you haven't done enough or the right work, you can sit in the PBL sessions and it just goes over your head and that's when you think "Uh-oh" but if I'm contributing and I'm understanding and being able to look at things and add to things that are already up there on the board, then I figure that I must be okay kind of thing. So it's the actual academic standard within PBL - but then again a big problem with that is if your group's not on the right track and says the whole group deviates then that's not reliable, I suppose.

Convinced we were all going to fail: I think because there's not assessment all the way through, like other courses, you just assume that you are doing the worst. There's always that feeling that - maybe it's just tied in with the actual course and the way it is - that you can just never know everything. Maybe it's part of that, or maybe it's just because it moves so fast. I just know there's general consensus that everyone's going to fail. This year, everyone was convinced they were going to fail the mid-years [2nd year] but then we all got them back and we all did really well and said "Oh, it can't be our exam".

Reese: Epistemological Analysis

Certainty of Knowledge

Reese demonstrates that she is on the sophisticated (higher) level of this dimension. She views knowledge as being of a fluid nature and has progressed to understanding that knowledge is relative and evolves and is modified in exchange with others.

This fluidity of knowledge is interpreted from Reese's comments "the more you know, the more you realise you don't know". These were reflections on her first year of medical school. Thereafter, she described "having a fresh start" in second year. She related this to an understanding (developed over time) of grasping the concept of PBL, which requires a fluid interpretation of knowledge. This altered her previous view of knowledge as consisting of lots of detail and, therefore, of a fixed nature. She came "finally to realise exactly the point of the process" and this affirmed for Reese that knowledge was evolving and modified in exchange with others in her learning environment.

Simplicity of Knowledge

Reese is on the sophisticated level of this dimension, as she views knowledge as highly inter-related concepts and not as an accumulation of facts.

Reese's views are clearly portrayed by her struggle over 18 months to "just realise now that it's all interconnecting". Therefore, she has progressed from viewing knowledge as just an accumulation of facts. Coupled with recognising that she didn't need to go into "every single step, cellular…chemical" but focus on a more holistic approach suggests that Reese has moved towards the sophisticated level of knowledge. This holistic interpretation of the nature of PBL enabled her to view that "everything ties together" and, thereafter, view knowledge in PBL as inter-related concepts. In addition, she progressed to relating what she did in the PBL group to

her clinical days in hospital. This enabled Reese to view knowledge as highly inter-related concepts and to finally state “you get the clinical thing”.

Source of Knowledge

Reese demonstrates that she is on the sophisticated level of this dimension. She views knowledge as being constructed by herself in interaction with the environment and others. She has progressed from viewing knowledge as originating outside herself and residing in external authority from which it may be transmitted.

There were three components in medical school that were instrumental in Reese’s situation. These were the authority and role of PBL tutors, dominant PBL group members, and the PBL process. Reese described the limitations and unfairness of these components. These were especially distressing to her as she made the adjustment to medical school. However, her experience with each of these components contributed significantly to her development as a sophisticated learner.

There were elements of dysfunction within the PBL process that Reese perceived (i.e., ineffective tutors and dominant group members) to be a major issue for her when adapting to medical school. However, these same elements prompted Reese to begin the process of constructing knowledge herself as opposed to relying on authority. For example, Reese’s experiences with an ineffective tutor in one semester led her to complete each case from start to finish over the following weekend. This required Reese to work on the PBL cases individually and to begin to construct knowledge for herself. In addition, Reese described “the most annoying is the dominant people; just because they've got the authority…nobody questions their content”. Initially, Reese relied on these students as an authority. However over the course of the first two years, she questioned their knowledge, which she found to be incorrect. In Reese’s experience, dominant students “really alters the functioning” of the group and created a dysfunctional PBL process. This dysfunction was the impetus for Reese to move well beyond her initial reliance on authority to constructing knowledge for herself.

Justification of Knowledge

Reese demonstrates that she is on the sophisticated level of this dimension. She has progressed to evaluating her own knowledge in the context of the PBL learning environment and can substantiate and justify these beliefs. Reese does not justify her beliefs from the observation of others or authority or on the basis of what feels right.

The components of most significance that describe Reese's views are the PBL process, examinations, and peers. Reese's experience of living with other medical students in college (described in Reese's vignette as 'There's No Escape') indicates that she looked towards authority in the first year of medical school. In relaying the breakdown of her peers in college, she reasoned "the biggest downfall is there's no concrete gauge for yourself" and "it's purely because they don't – we don't – know what is enough". Reese was seeking a concrete type of authority to justify her level of knowledge.

Similarly, Reese also looked to the authority of peers in her PBL group. She quoted deferring to the dominant students who talked with authority as a guide initially. However, over the course of first year, she realised their expertise was un-examined by the tutor and began her own examination of their knowledge claims.

After her initial reliance on peers and authority, Reese began to focus on her ability to understand the concepts that are discussed in a PBL session. This illustrates the beginning of a shift to a more sophisticated level of evaluating evidence in context. For example, Reese describes how the session "just goes over your head…and you think uh-oh" compared to "if I'm contributing and I'm understanding…..then I figure I must be doing okay kind of thing".

Further to her progression in evaluating evidence in the context of a PBL session, Reese demonstrates she can also evaluate the evidence of experts. This is shown by her use of the case wrap-up session as "a really good indicator of how well I have understood a case". These sessions are conducted by experts in the field. Reese's progression to evaluating her own understanding based on the evidence from experts demonstrates a sophisticated level of justification of knowledge.

Reese: Summary

There was evidence of all four dimensions of personal epistemology within Reese's experience. She is on the sophisticated level of these dimensions. The components in the learning environment of the most epistemological significance to Reese were the role of the tutor and peers. Her experience of dysfunction and discord within these roles resulted in a shift in her own role as learner. However the limitations she cited were instrumental in her development from the naïve to sophisticated perspective.

Catherine: The others were just taking what I said as Gospel

I must admit it took me a good semester to pretty much get into it – just learning – getting into my own routine and organising my work. First semester was tough because I didn't really have any idea and the first PBL group I was in we kind of had a lot of leaders in our group and I was a bit intimidated and scared to speak up and so it was tough trying to figure out what I was supposed to do and how I was supposed to speak up and stuff like that. In the second semester my group kind of helped me because we all kind of encouraged each other and I became friends with someone who was in my boat sort of thing, and we kind of did it together. We'd go through like a case together and we'd get our first sheet and then look at it and think okay, what do they want us to take from this sheet - because they want us to take something from every sheet - and so we'd list that down; do we have enough knowledge on all of those topics and if we don't it's a matter of going out, researching, finding out which books are the best and you learn that as you go along, which books help you the most. The next session we'd get a list of learning issues and we'd get our sheet on the history of the patient and make sure that you know everything; you understand like what all the investigations are and what they want next session so you can look into that and be prepared and then they've got lectures that help you along as well. So whatever you learnt from the lecture you could always bring in and resource as well and, yes, so just building up this knowledge and then at the end of each session it's just a matter of summarising it all into one case wrap-up and, then, you're just set for exams I guess.

Lot of leaders in the first Group: I just always took what they said was gospel! I thought they're so smart and they're very strong and even if they would say something and I'd think maybe that's not right I was too intimidated to speak up because I was just shy and I wasn't really sure about the processes but I've kind of learnt now that if somebody says something and I'm not too sure I will speak up. I might be right; I might be wrong. But I think that I've put that into the group and I make sure that I understand too - I haven't got any doubt. There was one case and a person was giving a mechanism and there were a couple of steps where I thought I think that's back to front but I never said so, and I went back and looked into my books and found that I was right so it was good to clarify. The next PBL group I'd kind of picked up how to do it and so I could do it by myself.

Why didn't I figure that out? At the start I didn't really know what they wanted us to know, how much they wanted us to know, but I guess over the year I've seen the level of knowledge we're expected to know and I can kind of predict what I should know and what I shouldn't know, in a way. When it comes to the end of each case we've got a list of the case objectives and - if I was able to cover those properly - I kind of know I'm on the right track. If there's a case and I didn't get all the objectives, then I'll say "why didn't I get those objectives"? "Why didn't I figure that out"? And making sure that I understand it for that next time I do. I think it will always - it will always be up to you. Like to figure out a case you obviously have to know the basic physiology of the body properly and so when it comes to the end of the case and I'm looking at treatment and say this drug works in a particular way to do this, if I

haven't looked at the physiology properly then I'd be thinking why does it do that? I think - hang on - I haven't looked at the physiology right so that I know how the treatments work. So it always fits in nicely and so if you've covered it properly everything will fit in well but if it doesn't there are always some question marks

If I can explain something, I know I understand it: I find that if I'm able to explain something without even my notes then I know that I understand it, I've grasped it and I'm doing okay. Also if I can be organised enough as well it's all good; it's all working well so that I'm not finishing off a resource like 11 o'clock the night before, that I've done it all well, because rushing, I don't tend to do as well. So if I manage to have a good however many hours for resource and covered it all and the next day I'm doing really well and I understand everything then I feel good. Like Monday night I do resource. Tuesday night PBL. Wednesday night is clinical skills and Thursday night PBL. Every night there's always something to do and then on weekends just catch up or summarising. Friday night is working; Saturday night is working; Sunday is working. I have my job as well but it's a matter of fitting that in as well. Yes, usually Sunday nights I like to do a bit of work - Saturday days and Monday morning before PBL.

Now if it wasn't PBL it would be tough. I couldn't imagine it. I'm just so used to PBL now, which is funny. I hated it at the start. It was really hard to get used to. Now I like it. With just lectures and resource I guess you could kind of prepare for a lecture, but why prepare when they're just going to tell you anyway. I think it would be more they're directing your learning from lectures and stuff like that, rather than you directing your learning. They're telling you what to know and what not to know and you don't really have much of a say, so I don't like that.

Just taking what I said as Gospel: Last semester my group was not enthused – and I think you have to have a sort of enthusiasm about PBL to get anywhere - and they just weren't really into it all that much so it was on me to look up all that stuff and contribute pretty much everything and it was tiring and just wasn't very enjoyable. I felt they never really ever questioned what I said or knew what I was talking about so I thought what if I didn't read that right, what if I wasn't correct, you guys are all taking what I'm saying for gospel; they think that it's right when it might not be. It's not fair because I think that the purpose of being in a group is to help each other and correct each other if we are wrong. It was difficult, so although I love my physiology I had to focus more on other things because nobody was really going to contribute. So I'd come back from PBL knowing what I have to do and say from the start you'll have a basic history of the patient and then hypotheses and then it's a matter of testing your hypotheses or getting a proper knowledge like all of the hypotheses, the physiology and history and examination - so you've got to cover all of that and make sure you're prepared for next time. So next time you have to be thinking through: okay, what will I need to look through? Look at my books for next time for the investigation - all of this, all of that - and so you just remember it all and then go home and look it all up and then bring that with you next time and it was tiring!

Helping others benefits me as well: If I know there's somebody in the group who has trouble with a certain thing that I can help them with I make sure that the next time I can explain that to them properly so they understand. So it kind of benefits me as well doing all that learning business. But with this last group by the time it came to exams I got really –really- prepared because I'd covered everything in depth but it was just really really tiring. Plus I had a tough elective as well and I hate my job and it just gets really really crazy and it's tough and then like my health, I know that if I don't get enough sleep then I'm in trouble so you have to look after yourself because the amount of study you can do, you could just study all day and all night and still not be finished. You have to know, okay, I think that's sufficient knowledge because you have to say no. You have to stop at a certain point otherwise you'll just burn out. It's just too much. What helps is that if there's ever anything in too much detail they'll (med school) always give us a lecture on it to make sure we understand it more. They always do, I must admit. Also I look back and think gee, did I understand it all? Yes. Did I cover everything? Yes. If I haven't, then okay, why not? Could I change that? Should I study harder? How shall I change my study? Yes, it's better. That's kind of helped me a lot, doing it piece by piece.

Catherine: Epistemological Analysis

Certainty of Knowledge

Catherine is towards the sophisticated level of this dimension, as she views knowledge as fluid and evolving in exchange with others. She describes taking a semester to get used to the knowledge required, but worked with a friend from PBL who was in the "same boat". In relation to the fluidity of knowledge, Catherine describes the process of building knowledge from her own investigations and from the resources provided by the medical school in terms of lectures, resource sessions, and PBL learning issues.

Simplicity of Knowledge

Catherine's knowledge clearly consists of highly inter-related and complex concepts. She frequently questions looking at the all the components of the PBL case properly so "they fit in well" and states that there are question marks if they don't. Throughout her narrative, she describes the methods used to assess whether she has understood everything in context and often takes the time to explain concepts to others in the group who are having difficulty. Catherine never refers to knowledge as simple, isolated facts; rather, she is focused on getting a proper knowledge of the PBL case and refining and testing the hypotheses over the course of the case.

Source of Knowledge

Catherine is towards the sophisticated level of this dimension. She initially described how, in the first semester of first year, she used to take "as gospel" what dominant leaders in the group said and was intimidated by the PBL process. However, rather than being hindered by this in a negative manner, this proved instrumental in Catherine's development from viewing knowledge as originating outside the self from others to actively constructing knowledge for herself. This developed further through her experience with a non-enthused PBL group which was reliant on her to contribute "pretty much everything" because "nobody else was really going to". She expressed the unfairness of this as in relation to the role that everyone should play in the group learning process to "help each other and correct each other". However, although this situation was difficult for her, she was also able to see it in a positive light, as describing it "kind of benefits me as well doing all that learning business".

Catherine expressed a similar view in relation to the source of knowledge in a scenario where there was no PBL and described how lectures "could tell you what to know and what not to know when you don't really have much of a say". This shows a very sophisticated level of the source of knowledge where Catherine is constructing knowledge for herself, derived from reason as a result of the investigations and her efforts.

Justification of Knowledge

Catherine demonstrates a sophisticated level of what she knows and evaluates that knowledge. She does not see knowledge as requiring no justification, but rather clearly articulates her efforts of justifying her beliefs through the evaluation of evidence and expertise. This developed as Catherine learned to question the 'received knowledge' of others in the PBL group and progressed to 'evidence judged in context'. She clearly explained her process of understanding and integrating all the resources provided by the medical school and the PBL cases and her use of the learning objectives and case wrap-ups to validate her understanding. She describes having learnt to do this after her experience of the first PBL group: "I could do it by myself and it will always be up to you". Thereafter, she described, when contributing to the group, that she didn't have any doubts based on her own investigations of the learning issues. She was able to discern when she has sufficient knowledge to stop learning and cautions that this is important as otherwise "you'll just burn out". Catherine substantiates her experience of evaluating what is sufficient knowledge from the guidance of the experts at the medical school, who always gave lectures on topics which required more detailed understanding.

Catherine: Summary

There was evidence of all four dimensions of personal epistemology at the sophisticated level within Catherine's experience of learning in medical school. The components in the learning environment that were of the most epistemological significance for Catherine were her use of lectures, overall learning objectives and case wrap-up sessions towards her goal of understanding and integrating knowledge in context. The two dimensions of source and justification of knowledge were highly related for Catherine, who frequently inquired of herself "why didn't I figure that out"? She displayed a high level of routine and organisation to combine her demanding paid part-time work schedule with her studies. Catherine's early experience of being in a group of leaders was also instrumental in her development of relying on her own internal source of knowledge. This experience enabled her to cope with the non-enthused PBL group and she was able to turn this negative experience into a positive one.

Beth: I really know where I'm at

The PBL process obviously it's going to change each time you have a different group and - you've probably heard from other people that say it's so dependent on the tutor or the group - which I think it is - but at the end of the day, I think it really comes down to you. Because of the group dynamics, if you don't look after your own learning you're really not going to get through the course curriculum. So I really think that you won't learn it unless you go away and do it yourself.

I really know where I'm at: The group and the tutor is a big influence but the major influence for me is how up to date I am, whether I've covered all PBL learning issues and done the resource. Also - it's just sort of how I feel - in general discussions in the PBL group - and when you talk to friends and stuff. Also looking at case objectives and whether I feel confident influence how I'm going. I think I really know where I'm at. I know how much work I've done, what I need to do, whether I've kept up with the learning issues, whether we've got an idea of the case objectives already, or the resource sessions. I feel like there are some cases I'm really on top and some maybe not so much, but to me it's usually pretty clear what I have to do and I just need to do a bit of revision and then that's it, sort of thing .

I just believe myself that I can do it: I think at the core, regardless of anyone, I know how much work I've done or I know how much I need to do and what I need to cover and why I do it. I know I have certain under-lying knowledge and understanding in med and I'm confident of the fact that if I do the work that I'll understand and won't have a problem. I'm not sure how it is for other people. So I guess that would be a big thing for me, like being so self-reliant. All throughout my whole schooling career, I found I often did well without a lot of effort compared to other people and that when I did put in effort I did extremely well and - this is how my life has gone - it can just be on that extra bit of work that I do. So I'm pretty confident in where I'm at.

You've probably heard already about the exams: I know a lot of people - they still approach exams the way they do in high school -a lot of people who still cram and still do it that way. I know that obviously the best way to do it is work through the cases at the time and learn it, understand it as you go. I like to think; hopefully I keep up to date. I guess we all sort of felt like, mid-year exams a lot of them weren't a good sort of portrayal of what we'd learnt. I was happy with the way I went, but even so - you've probably heard already - one of our exams they repeated three questions from last year and I feel that because I went through last year's paper like one or two nights before, that helped me more than my actual study! I think in the multiple choice section of one of our exams there was, I think 70 questions and about 50 of them were repeated in the last two years' exams and it didn't require much effort to learn for that because you remember the answers from the previous years and if you've gone through them once, that's enough to know. It almost seems like luck, you know the questions you get and which case and what elements of the case you get. I'm just so surprised at sometimes the diversity of questions. Some of them are so general and some of them are so specific and there doesn't seem too often be the right balance of gauging our understanding. It's almost completely sort of random!

You've got to impress the tutor: I think in the PBL groups - a lot of what motivates people - and I know to a certain degree myself, is that reputation and saving face and keeping up with everything because you've got to I guess impress the tutor and be able to engage in discussion. The previous groups I've had it was more of a collaborative effort but the group I'm in now it's a lot of self-learning and everyone goes away and everyone does that, and you know, I'll do this and you do that. The group I'm in at the moment - I've been talking to some other members of the group - we agree that it's a bit dysfunctional - a bit different from the others. I think it's because of a few students and also because of the tutor. In my last group I had a GP, like with a lot of clinical experience, and currently we have someone who has had a bit of experience but not as a doctor and a lot of it is directed by us. I think she is easily persuaded by the influence of students. I'm not saying that's necessarily a bad thing but I think - strong personalities seem to dominate - I'm not sure. It's hard thinking about this group. By comparison, last semester I had a fantastic group and a tutor with a lot of clinical experience. He was constantly getting us to re-assess and always giving us lots of journal articles and things that are really relevant I thought, and really getting us to think of it in a clinical setting, asking us lots of questions that I knew weren't just from the tutor handbook and involving everyone in the group. You're always going to get people who talk more and people who talk less and that sort of thing but I think, on the whole, the responsibility was shared. And I'd find our tutor would often engage people who weren't saying much or if someone got cut off they'd be brought back to say more or individual people were asked questions that really put them on the spot, to see if they'd done the stuff.

Sometimes in PBL it's a matter of who is going to talk today: In the group I'm in at the moment, I think it's kind of whoever has information jumps up and puts it on the board or talks the most. Sometimes in PBL it's a matter of who is going to say the most or who is going to talk today. Not necessarily, a collaborative effort. I think everyone is trying to get through it as fast as possible and so we go "why don't you do that and I do this" and I think it is probably not as cohesive as it could be. It would be quite easy to get away with not doing much work at all because certain people dominate. So a lot of it comes down to the tutor and being aware of the individual nature of the group and constantly re-assessing everybody within that. So this current group I'm in, the tutor thinks that if people aren't voluntarily contribute - she thinks that's their prerogative - do you know what I mean? She won't engage people to say "What did you get for this?" or "What do you think about this?" or "'can you tell me about this?" She sort of directs it towards the group and even though I suppose there's nothing wrong with that, it just doesn't encompass everybody. And I guess you know that you've got to get a decent tutor report. Although I often don't think they're a good indicator of exactly what you're doing: it's more your role portrayed in the group rather than an actual indicator of your learning and I think that role can be easily manipulated. I don't want to look stupid: For me, my own participation in PBL group is a big determinant of my motivation. In the PBL session I like to talk a lot and discuss and communicate and if I feel I can't do that then I feel I'm not up-to-date or I don't know things well enough.

Beth: Epistemological Analysis

Certainty of Knowledge

Beth's analysis demonstrated that she is on the naïve (lower) level of this knowledge dimension, as she views knowledge as being of a fixed nature. The epistemological components that formed the basis of this interpretation were the PBL case objectives, learning issues, and resource sheets.

Beth gave the impression she was very confident in her level of knowledge. Closer interpretation showed she viewed knowledge as being of a fixed nature, rather than viewing knowledge as being modified in exchange with the environment. For example, she focused on covering the learning issues, case objectives, and resource sessions. Her aim was to "keep up to date" and she emphasised that she knew how much was needed to be done and "what I need to cover". In addition, she discussed for some cases: "I'm really on top of and some others maybe not so much". These descriptions focused solely on coverage of knowledge. The process of covering all the components Beth described (i.e., resource sheets) showed that she viewed knowledge as fixed. There was no discussion of knowledge being modified and evolving in exchange with the environment.

Simplicity of Knowledge

Beth was on the naïve level of this dimension, although there is less evidence to demonstrate this compared with the other students. This may be due to Beth's pattern in her interview of declaring her competence and confidence in her abilities. However, she did not describe her process of learning to the same degree. For the same reasons, there was little to demonstrate she was on the sophisticated level.

Beth's focus on covering all the various components listed in the previous section on Certainty of Knowledge (i.e., learning issues, case objectives) provides some evidence of how she viewed knowledge. This suggests that knowledge was discrete knowable facts. Beth did not progress to discuss whether she integrated this knowledge in the context of learning. Therefore, it was determined that she viewed knowledge as being an accumulation of facts and not highly inter-related concepts.

Source of Knowledge

Beth views knowledge as originating outside herself and residing in external authority from whom it may be transmitted and, therefore, not as constructing knowledge for herself in interaction with the environment and others. She is on the naïve level of this epistemological dimension. The

epistemological components that formed the basis of this interpretation were the PBL tutors, PBL groups, and the role of peers.

Beth's opening statement in her interview was "you've probably heard from other people that it's so dependent on the tutor or the group" and was followed soon after by declaring "at the end of the day, it all comes down to you". These two quotes are instrumental in Beth's analysis. In the second quote, Beth professes the belief that she has a sophisticated view and constructs knowledge for herself. The first quote more accurately reflects Beth's epistemological views. That is, Beth views knowledge as originating from outside of herself and in the authority of the tutors. For example, in relation to the tutors, Beth described the role of the tutors as being responsible for the effective functioning of the PBL process, the PBL group, and the individual participation of each student. She was extremely dissatisfied with her current tutor and group as "it's dysfunctional" and felt her tutor was "easily persuaded by other students". Beth reported her tutor "wouldn't engage people to say…can you tell me about this" and concluded in frustration that "the tutor thinks that if people aren't voluntarily contributing – she thinks that's their prerogative – do you know what I mean!"

Beth compared her current experience, which she labeled as dysfunctional, with that of "a fantastic group and tutor" experience. This tutor provided extensive direction and extra information in addition to the PBL resources and "asked questions that really put people on the spot". Beth preferred the tutor who provided more direction and information, and who was more in control of the group process. Her description of this tutor was similar to the role of a high school teacher. It appeared that Beth was reliant on the role and authority exerted by this tutor, which influenced her dissatisfaction towards her current tutor. This shows that Beth viewed knowledge as originating more from the authority of the tutor who transmitted this knowledge.

Beth: Summary

There was evidence of three of the four dimensions of personal epistemology. The evidence for Simplicity of Knowledge was inferred from Certainty of Knowledge. Beth is towards the naïve level of these dimensions. Beth frequently emphasised confidence in her learning process, but her epistemological views did not demonstrate they were at a sophisticated level. Therefore, her views did not develop over the course of medical school.

The components in the learning environment of most epistemological significance to Beth were the PBL case objectives, learning issues, and resource sheets. Additionally, the role of PBL tutors, her peers, and the PBL group function were of significance for Beth to highlight the dysfunction she interpreted from her learning environment.

Beth's story was included to illustrate that being confident does not always equate to being competent in the learning environment. Beth exerted a high level of confidence in her academic knowledge. However, in practice her focus resided externally on her interpretations of dysfunctional PBL groups, ineffective tutors, and students who did not engage in the process collaboratively.

Summary of Epistemological Components in Medical School

The components of the learning and teaching practices of most epistemological significance to students were primarily the role of their tutors, peers, their own role as a learner and the PBL process, and functioning of the group. Notably, the role of peers was not identified in high school experience. In medical school, however, interaction with peers is a defining characteristic of the PBL process.

Students interpreted these roles and components differently, depending on their experience and epistemological beliefs. Perry documented this phenomenon in his last work, aptly titled *Different Worlds in the Same Classroom* (1971). The interpretation of the role of tutors illustrates these differences. Students who held naïve epistemological beliefs expected a high degree of direction and guidance from their tutors similar to the role of their high school teachers, and often expressed dissatisfaction with their tutors. In contrast, students with sophisticated epistemological beliefs did not expect the same level of direction and guidance. In addition, they rarely discussed the role of tutors and focused more on the additional responsibility they assumed for their own role as a learner. Therefore, the role of the tutors was not interpreted as being of epistemological significance to students who held sophisticated beliefs.

Patterns of Epistemological Beliefs between Students

There is a pattern of epistemological beliefs between the highest and lowest ranking students. David, Beth, Cameron and Jamie were analysed as holding naïve epistemological beliefs and were from the lowest academic ranked group of students. Whereas Gordon, Bailey, Catherine and Reese were analysed as holding sophisticated epistemological beliefs and were from the highest ranked group.

Chapter Summary

This chapter demonstrated evidence of the existence of the four dimensions of personal epistemological beliefs, as hypothesised by Hofer and Pintrich (1997), in the context of the medical program. A pattern of epistemological beliefs was evident for students from the highest and lowest academically ranked groups. The epistemological components of the learning environment, according to Schwab's framework, provided evidence that students from these two

groups interpreted these components in qualitatively different ways. Students from the lowest ranked group demonstrated dependence on the role of their PBL tutors, peers, the group process and the role of specific learning issues within each case. These students expected a high degree of direction similar to what they experienced in high school, and focused on covering the material they perceived was required to pass the end-of-year examinations. In contrast, the highest ranked students were not dependent upon their tutors, peers, nor the PBL process. These students took responsibility for their own role as a learner and guided their way during the PBL process, and extended their knowledge past the specific learning issues in pursuit of greater depth and breadth of knowledge that was expected over the longer term of studying medicine.

By the end of second year in the constructivist medical program, both naïve and sophisticated epistemological beliefs were evident in the student sample. Some students had retained the naïve beliefs they held from the beginning of medical school, whereas others progressed to more sophisticated beliefs. A small number of students demonstrated sophisticated beliefs from the beginning of medical school.

The next chapter addresses whether epistemological beliefs are related to the process of learning in the context of a PBL medical curriculum. These beliefs were captured by a 'think out loud' interview protocol, whereby students described their thinking from the start to finish in a PBL case. These were analysed according to the four dimensions of personal epistemological theory. The results are presented as comparisons between students from the lowest academic ranking and students from the highest.

CHAPTER 7: EPISTEMOLOGICAL PERSPECTIVES OF PBL

Introduction

This chapter focuses on the process of student learning in PBL from an epistemological perspective. Student views were captured by the 'think out loud' interview protocol (Wineburg, 1998), where each student recounted their approach to a PBL case. However, as outlined in Chapter 3, these interviews were crafted into shorter narratives for inclusion in the body of this thesis. These narratives included the factors of most epistemological significance for each student in his/her approach to PBL. Collectively, they represent the depth and breadth of students' epistemological views in this context.

This chapter builds on the progressive reporting of results which began more broadly with the epistemological analysis of students' experience of high school in Chapter 5, followed by analysis of their adaptation over the first two years of medical school in Chapter 6. The analysis was based on interpreting each student's approach to PBL within a theoretical framework of personal epistemology (Hofer & Pintrich, 1997). The results and discussion are in the format of a comparative analysis between students from the highest and lowest academically ranked groups. The pattern of epistemological beliefs that emerged between these two groups is discussed. In addition, whether these beliefs influenced the students' process of learning in PBL is examined.

The Cognitive Constructive Approach to PBL

Additional findings emerged in relation to two of the criteria from the cognitive constructivist approach to PBL. These were defined by Schmidt et al. (2011) and outlined in Chapter 6 (page 98). Examination revealed that these two criteria are congruent with some aspects of epistemological theory. Therefore, the existence or absence of these criteria was also examined in this study. These findings are discussed in the context of their relationship to personal epistemology. The description from Schmidt et al. (2011) is re-stated here for clarification prior to reporting the results that linked aspects of this approach to personal epistemology.

> PBL is a cognitive constructivist approach which defines the purpose of PBL as helping students to construct mental models of the world. … In PBL, learners are presented with a problem in order to activate their prior knowledge. This prior knowledge is then built upon further as the learners collaborate in small groups to construct a theory or proposed mental model to explain the problems in terms of its underlying causal structure. As learners continue to study related resources, their initial mental model is further modified and refined. Moreover, as the learners' preconceptions are activated, they become more easily able to identify gaps in their prior knowledge, thus enabling better learning to take place (the activation-elaboration hypothesis). (Schmidt et al., 2011, p. 793)

These authors concluded that the process of PBL works because "it encourages the activation of prior knowledge in the small-group setting and provides opportunities for elaboration on that knowledge" and "the extent of learning in PBL results from neither group collaboration only nor individual acquisition only; both activities contribute equally in learning in PBL" (p. 792).The latter part of the analysis investigated whether there was any evidence of these two criteria during students' recounting of their 'think out loud' approach to PBL.

'Think Out Loud' Interview Approach

The majority of students engaged in the 'think out loud' interview approach based on their last PBL case. Students were asked "What were you thinking while you worked through this case?" The framework of the four sessions in the PBL case was useful for students who had difficulty articulating what they did in PBL. Other students expanded on the PBL process more generally. These differences were reflected in the narratives. These are presented as pairs of narratives and were purposely selected to highlight the major differences in students' interpretations of the PBL process. These pairs are listed in Table 11. Each pair is followed by the comparative epistemological analysis. Following on from this are the results of investigation into whether there was evidence of the two criteria from the cognitive constructive approach to PBL.

Student Narratives

Table 11 Pairs of Student Narratives

1st pair	David: It's just looking at what other people in the group do (Lowest Ranked Group) Gordon: I hate being held back and slowed down by the group (Highest Ranked Group)
2nd pair	Cameron: The other students do all the learning – not me (L) Bailey: I've always gone further than my PBL group (H)
3rd pair	Jamie: I usually know a little bit about it (L) Reese: I do a lot more to get the whole picture (H)
4th pair	Beth: It depends on your group and what path they take (L) Catherine: Do **I** understand all of that? (H)

David: It's just looking at what other people in the group do

Session 1: First session it's pretty much just a matter of having a look at a new problem then going through some hypotheses with the group. From there, basically what I do when I go home is I work out what I think is going on, and I also look into some hypotheses. Some cases we had at the time I had not much of an idea what was going on, so it's me taking what **other people** in the group have said, and then you get some knowledge off **other people**. We go home and we analyse things basically – and do this sort of stuff. You generally pick up things as you're going along. Things just start fitting into place, so basically they review the history, what sort of features fit in with that, then from there look at investigations and things like that. We come up with, say, four or five hypotheses, of what we think are going on, and then from there we look into each one. I'd read up a bit about it, see if it fits in or not, then we have also learning issues, as well, so I go for them.

Session 2: First session's hard, then second session you look at what **other people** have brought back to the table. Basically just look at what **other people** have done. Everyone sort of had their own look, for review, of what they think is happening. Then from there everyone reviews or gives a bit of info on what they've done, so basically look at what **other people** have done and look at what I've done as well, in comparison. From there I look at what I need to go through. If they've gone through something different to me, I'll go through that in my own time. Generally you can just tell whether it fits in with what's going on with the history and things like that. The tutor also gives us a bit of a guide as well. We'll also brainstorm to see if we think it's possible that this has happened, but most of the time you can actually just tell I think when things are fitting in and when you're going off the topic, and then you know.

You generally just tell, I think. You just get a sort of sense like you're wasting time and going in circles**.** Over time you just learn to – because in first year you probably won't tend to, but in second year you definitely know – things start focusing on what you think is going on, how much you need to know and things like that as well. I look at whether what I've brought back is similar to what **other people** have done as well. That's the main thing. Basically look at what **other people** do. I think everyone really looks off each *other* to see what they went through, or they didn't go through, what everyone thinks we should go through. Basically there are things that everyone should look into in more detail and things you can just put aside and you can do in your own time, it's not that much of a major deal. After Session 2 I do some more reading. Then we have physical exam results and things like that. Basically I just read more, some other stuff. Then you try and relate that back to what's actually happening with the patient. Again, it's generally a group decision what we think we should focus on. It's *the group* that decides what to focus on and what sort of questions they ask.

Session 3: I look at what I've done compared to **other people**, how much detail they go into, what other things they looked into besides this. If I think I haven't gone through certain things in as much detail as ***other people***, I'll go through that in terms of investigations and what we're looking at, or I might have done other things or people might have different mechanisms of pathogenesis. That's basically what it comes back to, just really looking at what **other people** do, and the tutor also gives guidance as well. If

they think we're wasting our time, then they'll tell us and say "Just focus on these things more than other things".

After Session 3 we're looking at the management sort of thing, again we're reviewing information we're given in the session. We take that away. It's a similar thing that we do each session; it's just that we're looking for different aspects here. By this stage we pretty much know what's going on with the patient and we're just looking for further management. Again, we bring that back to session four.

Session 4: We look through that sort of stuff again and basically just pick out the key things that we think are important. It's really done, sort of, a group process. Pretty well democratic in terms of what we think we should be doing. Then by the time we get to session four, re-read info and we review what we think we should have taken out of the case. It's a re-learning of objectives. Then we're given feedback by the tutor, as well. They'll tell us during the case we maybe didn't tell her as many things or as many key points as we should have and also we get told to look back on those things, or look in areas in more detail. Overall, it's definitely looking at what **other people** have done as well. We all look to each other and we ask "did you look in to this" and that sort of thing.

PBL Process Analysis

David describes having "not much of an idea what was going on" and takes knowledge from other people in the group. He uses the term "you just pick things up" to describe the acquisition of knowledge. David views the first session as hard in comparison with the second session and relies on "what other people have brought back to the table". He assesses his own knowledge base by how it matches what other people have done. David believes "everyone really looks off each other to see what they went through". He is not able to articulate how he assesses his knowledge in Session 2, citing "you can just tell when things are fitting into place". He affirms that you can "just tell" and "you get a sort of sense like you're wasting time and going round in circles". Similarly, when assessing what to learn after Session 2, David advocates "it's the group that decides what to focus on and what sort of questions to ask."

In assessing his individual progress in Session 3, David reiterates: "that's basically what it comes back to, just really looking at what other people do". He acknowledges the tutor's guidance role, expressing it as: "if they [the tutor] think we're wasting our time, they'll tell us and say just focus on these things more than other things". By the end of session 3, David describes how they have collectively reviewed the information in the session. He uses the term "we take that away" again, highlighting the collective nature of the group in relation to knowledge acquisition. He surmises that "by this stage we pretty much know what is going on with the patient", with no further

elaboration on how this happens for him at an individual level. David describes the final session as a "re-learning of objectives" where "we review what we should have taken out of the case".

Activation and Elaboration of Prior Knowledge in PBL

David's perspective does not provide any evidence for the process of activation of prior knowledge and elaboration of knowledge in the PBL group. His experience is based on just picking up things from other people and getting a feeling that things start fitting into place. He focuses on what can be taken away from the group as a whole and what should be taken out of the case. Previously, David was described as being on the naïve level of epistemological development and this explains his view of knowledge acquisition in the PBL process. David views the group as his source of knowledge and does not seek justification from other sources. David demonstrates that he views the certainty of knowledge as fixed and the simplicity of knowledge as on the low dimension. His views of knowledge are that it can be "taken away" from the group in individual bits of knowledge in the form of answers to learning issues. David's description of what his study group does is a replication of the system he used at high school. From the explanation David gave of working through a typical PBL case, there is no evidence that he is actively constructing knowledge for himself, and no evidence that he is elaborating on concepts in collaboration with the group.

Group Collaborative Learning Versus Individual Knowledge Acquisition

David provides an example of one of the main arguments in this study that some students have a misconception of the PBL process, albeit after two years in the medical program. David refers to the collective term *us* in his description of the PBL process. He seems unable to separate what the group does from what he does. This indicates that David has misconceived the role of the PBL group and his individual responsibility for learning. David consistently uses the collective term for the group in response to questions about how *he* assesses his own individual learning. David relies on the group and not on himself.

Gordon: I hate being held back and slowed down by the group

It's not about the PBL cases and objectives. Irrespective of what case it is or the content - it's do I have a sound understanding, yes or no? It's as simple as that. No - then go do more learning; go find other alternative means of doing so. Yes - fine, take it easy. If I find I start tripping up and not knowing things or I find when I'm starting to draw mechanisms or trying to link into my mind to try and answer questions, if I find there's holes in my knowledge that don't allow me to complete that sequence that's when I find I need to stop, take a breath and think what's gone wrong. If I see other students shooting ahead of me or other students seem to have a really good grasp on certain concepts, I find there must be a breakdown somewhere. What do I have to do to fix that! So my progress is usually guided by mistakes. Sometimes if I'm starting to move to a more didactic style of learning and just copying out slabs I find that's when I'm not learning as well. However, if I approach learning in a method that's enjoyable and promotes understanding and comprehension then although it's a lot more difficult in terms of not being able to copy out one slab of text it's much more integrated in my mind.

I don't like working in groups with other people in terms of doing study group kind of work. I don't mind for the learning process- in terms of direction for learning - but when it actually comes down to the learning itself I don't like doing it with other people. I find I get slowed down and I might just be wasting my time explaining simple concepts to them that have been grounded in my mind. I would rather spend that time furthering knowledge and the intricate bits around the edges. I need the group for the PBL process in terms of directing me to a place of learning. Half the hypotheses or learning issues I would not come up with myself. I can totally admit that.

I need the group dynamic and the group's thinking to be able to take me - to get me those learning issues. But in terms of going away to research issues, I don't like doing that with anyone else. I like to do that myself. But I like coming back and comparing myself with other people and seeing what other trains of thought people have run down or what the things they've thought are. If I say "I saw this presentation on pain and I thought of this and I went and learnt all this kind of thing" and they're like "Actually I read this other book and this associated feature that I thought this" and "I'm like - shit - that's a really good idea. Why didn't I think of that"? So I'll go away and learn that and think about that. So, peers are good for stimulating learning and also for reflecting it but not for the actual learning itself.

Peers are my PBL group and certain people I talk to. Some people I talk to and to be quite frank, I don't really care what they think or what they know. This is going to sound really rude. I think they're pretty dumb but there are a couple of people I really respect their academic knowledge in terms of both med and the way they think and they've got a really sound learning style and their appreciation of concepts and if they start rattling off things I'm just like "What, when, where, how"? So you need to be better than them or you should at least be up to that kind of level. That kind of level will take you places, kind of stuff. There are a lot of slobs in med and I don't want to come out and do GP work. I want to do something really good.

I'm very short tempered with myself. I expect high of myself, so if I think "No I'm doing a crap job, no,

this is wrong, no, this is shit, then I'm like stop, reassess, what's going on, what's wrong"? It's just ingrained in who I am. I'm a perfectionist which can drive me insane sometimes. It's a pride thing as well. I've been given this opportunity. I'm going to do a good job with it. Again, it's a personal thing. I don't want to be sitting in the PBL room going "What's that"? and looking like a dumb ass. I want to know my stuff. Even if I'm not verbalising it and stamping my place in the group I want to know what's going on. I don't like being lost and left out in terms of that kind of stuff. I've always been that way. I don't know whether I didn't have any older siblings in my family that I could learn from or anything like that so I had to do everything myself and I still find that.

I find I'll only go to other people for clarification, not for actual teaching, unless they are very senior. If a fellow med student tells me a concept I'll listen to them and then I'll go away and look it up whereas if a consultant said it to me I would take it as gospel and I would just take that on board and I would remember it but anyone else I'd sort of take it with a pinch of salt, and that's really rude, I know. I hear people all the time sprout things and I'm just like you think you know what you're talking about but you actually don't and they're so confident in what they're saying, like –"No, I'm so right" - and I'm like "But, no, you're so wrong". I don't want to be one of those people that talks shit. I'm very sceptical unless they're a student that I really respect and know and I've seen in action before. There are certain students I think- they're good; and no, they're bad. So I'd follow the good ones. I hate being held back and being slowed, especially around exam time. I think that's why I'm a bit angry as well. I hate being held back and slowed down.

Sometimes I'm looking at a concept in PBL and I'm like, no, that doesn't explain it enough for me. I want to have a full picture and understanding of what's going on. If you read something and then it goes there's no known mechanism for this then I'm like okay, well I'll accept that, for granted. If there's something that goes right down to a molecular and cellular level I'm not going to need to know that but I need to know the integral steps in between that cellular level and the clinical presentation - what are those integral steps that I need to know for my complete understanding and I usually find that if I have that then that can be dumbed down for an exam or dumbed down to an answer for someone in the hospital. But if I have something that's very shallow and then I get my probe for the questions and I can't go any further I find then I haven't gone far enough. As an example, it could be a question you get asked from a consultant. A question like something about the kidney and could be like something that sounds very simple, like a really good question, and you've given a basic that sounds very simple and he's like "But why"? and if he keeps asking "But why, but why, but why"? I sort of keep answering until he stops asking "Why"? Once the whys stop that's generally when what's adequate.

PBL Process Analysis

The interview with Gordon about how he progressed through a PBL case took a different path from the other students. His focus was not on the PBL case or the learning objectives or issues that other students raised. Of note was the absence of any dialogue about the tutors. This can be explained by the level of self-determination he revealed in his interview, expressing: "What do I have to do to fix that?" Gordon expressed that the key to PBL was understanding and comprehension of knowledge as a whole and enjoyed the process of knowledge being "more integrated in my mind". For Gordon, working through the case session by session was not something that helped. He stuck to the fundamental process of gaining a "full picture and understanding of what's going on". All the other factors were peripheral to Gordon.

In Chapter 6, it was reported that Gordon came from a very competitive academic background and experienced difficulty adjusting to medical school. However, out of his struggle to learn, Gordon experienced a "baptism by fire". Therefore, it is not surprising that he is harsh on his peers as he is equally harsh on *himself.* He reflects on his own performance in the same manner: "If I think I'm doing a crap job, no, this is wrong, no, this is shit, then I'm like stop, reassess, what's going on, what's wrong".

Activation and Elaboration of Prior Knowledge

Gordon does not provide any evidence of elaboration of knowledge as a result of collaboration with the group. To the contrary, he stresses the importance of how he elaborates concepts in his mind and resents wasting time explaining simple concepts to the group. He believes he can do without the group process for elaboration.

Gordon emphasises: *"I need to know* the integral steps between cellular level and clinical presentation...that *I need to know* for my complete understanding". He cites being in a family where he had to do everything himself and still finds that to be the case. He refers to taking what other people say "with a pinch of salt". Gordon also vented his anger and frustration at fellow students in terms of "I hear people all the time sprout things" which Gordon knows to be wrong, but which other students assert with confidence are right. This suggests that there are deficiencies in PBL in relation to the activation and elaboration hypotheses for other students in his group. For example, as Gordon points out, the information may be incorrect in the first place and, therefore, they are attempting to elaborate on knowledge which is false from the start.

Group Collaborative Learning Versus Individual Knowledge Acquisition

Gordon paints a picture of individual learning over collaborative learning. He views "peers as good for stimulating learning and reflecting but not for the actual learning itself". He is frustrated by being held back by the group due to the lack of scholarship and ineffective group processes.

These aspects were described as: “wasting my time explaining simple concepts to them that have been grounded in my mind”. Gordon is able to “find holes in his knowledge to complete a sequence” independently. Gordon is very complimentary and respectful to other intelligent people and simultaneously sees them as competition: “you need to be better than them...that kind of level will take you places”. The individual nature of learning and competition within learning is well engrained in Gordon.

David and Gordon: Comparative Epistemological Analysis

In Chapter 6, it was reported that David was one of lowest academically ranked students and Gordon was one of the highest. The analysis showed that David held naïve epistemological beliefs and Gordon held sophisticated epistemological beliefs. This section summarises the differences between Gordon and David’s approaches to a PBL case at the end of their second year in the medical program. These differences are compared and analysed within the four dimensions of personal epistemological theory.

Certainty of Knowledge

David views knowledge as fixed and Gordon views knowledge as fluid. David continued with his practice from high school of “covering stuff’’ and relying on others, from whom he picks up information. David continues to see knowledge as a fixed amount and there was no evidence that David’s beliefs have altered over the two years. This is in contrast to Gordon, who underwent a fundamental shift and described the process of discovering that knowledge was relative and was modified in exchange with others in his PBL environment.

Simplicity of Knowledge

David still refers to knowledge as an accumulation of isolated facts. He frequently refers to “just sort of covering information” within the PBL process. In contrast, Gordon described moving away from the didactic process of learning slabs of information, as he did at school, to understanding and integrating concepts within a PBL case. His focus was on *understanding* everything in context, compared with *covering* isolated pieces of information.

Source of Knowledge

David views the source of knowledge as external to himself and residing in others. In particular, David depends upon the collective authority of his PBL groups as the source and transmitter of information to enable him to cover the essential material required for each PBL case. By comparison, Gordon is on the opposite position of this dimension. He clearly demonstrates now being an active constructor of knowledge as a result of his interaction with the PBL environment. Gordon specifically refers to the downfalls of relying on other students in his PBL group and

constructing the knowledge for himself. Gordon has developed significantly over the medical course, compared with the beginning when he cited asking other older students in his residential college to “just teach me”.

Justification for Knowledge

David is not able to justify knowledge for himself and relies on what he feels is right. In the context of the PBL case he still refers to things “just sort of fitting”. In addition, David is dependent on “what the group decides” and that “it all comes down to the group”. The phrase “looking at other people” is constantly used by David as a benchmark for trying to work out where his knowledge is located. By contrast, Gordon evaluates evidence in the whole context of the PBL environment and then integrates those views with those of his own. Gordon progressed to using evidence from a variety of sources, critically evaluating the knowledge from other students that he respects in the course, and integrating the views of experts and consultants.

Summary of David and Gordon

David’s ‘think out loud’ description of a PBL case demonstrates that he has not moved beyond naïve epistemological beliefs. He views knowledge as fixed and simple, believes knowledge originates outside himself and is unable to evaluate his level of knowledge. In contrast, in the course of working through a PBL medical curriculum, there is evidence that Gordon’s epistemological beliefs have developed to view knowledge as fluid and complex, and he constructs knowledge for himself and can critically evaluate this knowledge.

Cameron: The other students do all the learning – not me

What I would usually do is compare myself to a lot of my peers just through discussing, so within my PBL group I find just talking about the cases, like particularly at the end of the case we'll have a bit of a session where we're just discussing if we had any problems and just having a bit of a chat in a less formal manner, not going through learning issues or things though, just a chat. I also find talking with friends really helpful because there's a lot of variation between groups and so other groups will cover things in more detail and it also depends on the tutor so just talking to them, just having a chat and finding out what they thought important concepts were, just help me evaluate where I was going and see if I was doing the right thing just to see if I was covering the right aspects of the case.

Session 1: It's the start of a new case and usually it's something we haven't really heard of or it's pretty unknown - I know its student driven but our tutor helps quite a bit. He doesn't actually point it out to us but it's just helpful having him there and if you're going off on a tangent and it's not relevant he'll just go: "Okay maybe focus on this a bit more or not so much on this".

After the first session everyone is talking about the new case and you're just trying to find out what other people are doing. So just talking with friends finding out what they did, because it is tough after the first session. You're not quite sure, particularly after the first one you want a bit of guidance and knowing "Am I going to go home and do the right thing by learning the issues and things like that". During the session they will raise a lot of questions because the first session is just a lot of questioning like what is this or what is that and so I pick up on that and even though you will have certain learning issues and things like that you've got to sort of listen to what the group says because they're not quite sure about this. I'll just question it [the group] might not necessarily have it as a learning issue but you can still think about it, at the back of your head, they raised that question for a reason. Should I check that out or is it relevant. How I check that out? I don't know. I don't really; I just try to do everything that was listed and make sure I covered everything that we raised as questions and things like that. I just try to cover all that I can and knowing myself I think I've done it all and I have an understanding of what to do next. After session 1, I've done those learning issues and it's sort of predicting what's going to happen next because you have at least some background knowledge so you know what to do, so I just look at what I've researched and try and work out where to go to from here.

Sessions 2 & 3: Here, I think it's the degree of information that's important. It's pulling all the information we've got, pulling it all together because you won't find everything and someone else will have this other little fact. Once you get it all together it increases the understanding of the case, so the group is really helpful and helps assess "did I do the right thing and have I covered it in enough detail", because sometimes - you have a lot of learning issues after the first session and you realise you can't do all of them and also some people are going to cover to varying extents. You find that once you get back to session 2 there's that problem [did I cover things in enough detail] and also by pulling it all together you end up with a better understanding. I guess after session 2 you have more of an understanding so you progress yourself. Friends are important at the end of the case where you discuss everything but at this

stage just the group and just myself, just knowing, “okay, I’ve got some direction now”. So I study what we've discussed in session 2, what new points have been raised and any questions we want to answer. I find sessions 2 and 3 are very much the same because it's just building and building and the main things are the introduction and conclusion of the case and any changes.

Session 4: This is largely like the group where we are just wrapping everything up, pulling everything from the case together to try and reach - not necessarily they don't diagnose and don't lead to full conclusions - but just so you know everything that we've covered in the case and how it ties in with everything because you can just have a lot of loose facts everywhere and what did I use that for? But with the last session the group gets together and goes “Okay, so this is how that related to this problem” and things like that. I suppose in terms of case objectives that's where that comes into it, where we cover it in terms of working out if I have any gaps or missed things. I think about it again because I notice when we're doing case objectives a lot of people just put up everything there is to know, cover everything, and not all of its important so I just work out okay, if I did miss bits were they really important? And also I suppose talking with other people outside of the group to see if they had it as an objective and to see if it was relevant. But otherwise I just - I'm not a very good student- I'm not going to go out and learn about it straight away if I haven't learnt about it during the case. Because like the students do all the learning - not me. I think I just do things differently. A lot of people there are really hard workers but I'll take it as it comes.

With my friends being in different groups there's a lot of variation between what the tutor and what the group itself considers- student directed learning. What they think the important concepts of the case are and how much detail they go into it. Because you get the case objectives or you work them out but still you don't know to what extent to cover them and you didn't know if you were doing the right thing. Have I gone into too much detail with this one or is it a minor point and I think just gauging what other people have done and seeing what they think is a good standard for that particular objective or the case just gives you some idea of “have I done enough and have I done the right thing sort of thing”? Sometimes you think oh no I've completely done the wrong thing and it puts you under a bit of pressure so in some ways it can work against you because people will go this is the main point- I've done this much on it so I'm like I haven't done that much so it's a bit worrying. Look at the end of the day...I’ve come this far so I must be doing something right”.

PBL Process Analysis

In the beginning, Cameron gives a description saying "what I usually do is I would" and then continues to outline what he thinks he should have done. Cameron does not use the present tense. He seems to focus on what he thinks should be the *right* things to say, and there is a sense he is not engaged in the PBL process.

After the first PBL session, Cameron describes "trying to find out what other people are doing" and afterwards, in his private study, "tries to cover" all he can. Subsequently, in the second session, Cameron describes it as the group "pulling all the information in". He views Sessions 2 and 3 as similar in that it's just "building and building". In Session 4, he describes the focus as "just so you know everything that we've covered". Throughout his description of the progress of the 4 sessions, at no stage does Cameron outline how he comes to an understanding of the concepts of the case. Furthermore, Cameron continually defers to his friends and other students during the process.

Cameron cannot discuss how he learns individually, and continues to refer to what the group does and expresses "what they think are the important concepts of the case". Similarly, as with David, it was difficult to get Cameron to elaborate on how he understands knowledge and works out for himself how he has learnt something.

Cameron discussed fellow students in his PBL group who say "this is the main point" but, in contrast with Gordon who emphasised people who "sprout things" all the time, Cameron is unable to discern whether what the other students said is correct.

Cameron has difficulty in working out gaps in his knowledge. He "just has a think" about what concepts may have been important but cannot describe any active steps taken to remedy this situation. Towards the end of the interviews, Cameron discloses that he is not a good student: "I'm not like the others". The reason for this is that "other students do all the learning – not me". This resonates with the beliefs that Cameron expressed earlier about his role in the PBL process and his dependence on friends and the group.

Activation and Elaboration of Prior Knowledge

Cameron's description does not provide any evidence of elaboration. Cameron "just has a think" about things but is unable to elaborate on this further. He describes the "building and building" of knowledge as the PBL group sessions progress, but is unable to relate this to the understanding of knowledge. His reference to building seems to be related to the amount of knowledge presented. In relation to activation, Cameron has difficulty in working out whether he has firstly found the right materials and then studied them in enough detail to bring this back to the next PBL session. He does not describe being able to elaborate on this knowledge and to work out what

are the important concepts of the PBL case. He is more conscious of keeping up with the case, rather than understanding and elaborating on knowledge. At the end of his second year, he admits still having done the completely wrong thing for the PBL case. This supports the view that he is not elaborating on his prior knowledge.

Group Collaboration Learning Versus Individual Knowledge Acquisition

Cameron expresses a reliance on the group, gathering “what they have told me” and “what they think”, rather than outlining how he constructs and understands knowledge. It is also plausible that Cameron does not engage in group collaboration either. His disclosure that other students do the learning and he is not like the others supports this view.

Bailey: I've always gone further than my PBL group

Session 1: It's in the first session when we're presented with a clinical case I find it most useful. At this stage -rather than investigate certain disease states and pathologies, I always like to look at the specific symptoms and signs. Because if you're studying the course guidelines, or hearing from other students along the grapevine what the case is about, it's very easy from the very first session to open your books and start reading about a very specific disease because you know it will be relevant because you know that's what's the problem. That would give you a very specific knowledge in that disease, but it won't give you a very broad knowledge and it's broad knowledge which is required, I guess, in later years, and clinically. So in the first session I like to read on the symptoms and signs and, for example, on the last case I knew that the patient was jaundiced and I knew why they were jaundiced, but instead of looking at biliary tract obstruction I looked up jaundice and read about the different presentations and the different causes. So instead of in that first session reading about gallstones I studied jaundice and the different causes of jaundice and that led on to it.

I like to in the first session gather someone's standing in the way in which a doctor in clinic might approach that problem, and what you'd look for on physical examination to distinguish between the different causes. Normally it's after the second session that I read specifically on the causes of the specific types of, in this example, jaundice. So I might have read about viral hepatitis infections with the latest case, biliary tract obstructions, any hepatocellular diseases and at that stage I always like to make sure that I develop the broad knowledge of all the problems and not just the very specific knowledge for the problem that's relevant to the patient.

A lot of the time it's after attending all four sessions and once you have a bigger picture of the case it's a lot easier to sit down and make sure that you've covered all that's required. Because a lot of the time you'll come up to the fourth session and realise that there are a lot of things that you don't really understand too well, or things that you haven't covered so later you have to catch it up. Sometimes, each session being a few days apart doesn't leave much time. In the third session– hopefully by the third session I like to always be at a point where I understand the different common presentations and the underlying causes and by the third stage I like to start studying the treatment and management of the specific disease of the patient as well as the common – or the other common diseases which may have caused such a presentation.

You can judge how well you've understood things either by how well you are able to explain or take part in the tutorials. It's quite clear sometimes if you haven't done work you feel overwhelmed by the amount of information that comes out during the tutorials. If you're at a point where you feel comfortable with the level of work that your tutorial group's doing, then you feel as though you are at a point where you understand things well. You can always use your textbooks as well and feel as though if you've covered what's in the textbook then that's what would be expected of you at that point. I mean when you read internal medicine books they're normally split up into epidemiology, aetiology, pathophysiology and treatment management complications and so if you think to yourself, if you think do I understand

diabetes mellitus and you think okay, well what's the epidemiology of that and you think it through in your head what's the aetiology of it and what's the pathophysiology and if you break it down like that in your mind you can think yes, I understand why. You think "Do I understand the pathophysiology, why there's increased urine production and why there's thirst" - then you can. At the start of the chapter you'll read the presentations of diabetes are certain symptoms and later when you come back to the pathophysiology if you can explain the symptoms that you can remember the diabetes then you know that you've got a decent understanding of the disease. If you can understand why – if you have a good understanding of the pathophysiology and the metabolic abnormalities that are present - then you can see how the treatment fits in there, if you understand why the treatment works the way it does. I mean, you can, it's easy to just memorise it to give oral hypoglycaemic agent, but if you don't understand why - and if you don't understand the pathophysiology that the blood sugar is raised and that will cause complications - then you don't really understand the treatment too well. They're all interconnected.

I think a lot of people base all their work on discussions or objectives that are drawn from their PBL sessions and treat their PBL group's sort of depth of knowledge as the cut-off. Whereas some people might say "My peer group is a bit too sort of diligent for their liking". For me, I have never had a PBL group that's gone into a lot of depth over things. I've always found that I've gone further than what my PBL group has. I think that in the time we have together, which is about six hours a week, it's impossible to cover everything that's relevant to the case. So I'm pretty sure that most students would go past what their PBL group has covered. When I think of it, if the six hours a week I spent in PBL tutes were spent in the library doing my own work it would probably be more productive. Because out of that two-hour tutorial session, a lot of the time things which are covered are things which you already know. So you may sort of fail to concentrate for three-quarters of that time. A lot of people which I've spoken to have said they never learn anything from their PBL tute and I think, like me, guide their own way rather than taking the guidance of the other members of their group.

I tend to summarise cases a lot and break it down into different aspects – they're always interrelated as well, because some things are such large topics that if you don't reduce them down into smaller parts then you'll never really know if you understand it very well at all. There are only a few days between each session and so I try and put together everything from the case and try and fill in any gaps, either through just reading or just writing a few notes. I like to be very organised in the way things are set out and make sure that everything's covered. If I'm having a bit of trouble I might wander around to a few friends in other groups and ask? "Are you guys reading on this, are you reading on that" because there's so much that you've really got to concentrate on learning what's most important at the time and what's most relevant.

PBL Process Analysis

In the first session, Bailey can discern between taking the easier path of learning about specific diseases relevant to the PBL problem and the benefit of learning a broader base of knowledge which will be required in the future. Bailey describes his approach as one how "a doctor in clinic might approach that problem". Then, in the second session, Bailey reads specifically on the PBL topic to ensure that he develops the broad knowledge of the problems and not just the very specific problem for the patient.

By the third session, Bailey likes to be at the point of understanding the different common presentations and the underlying causes and then start studying the treatment and management of the specific disease of the patient as well as *other* common diseases. Bailey gauges his understanding by how well he is able to explain things and take part in tutorials. Bailey clearly describes how he comes to a good understanding of the material in the textbooks. It is not rote learning by the book, but instead he relates the information to concepts that he can break down, integrate and connect: "You think it through in your head what's the etiology of it and what's the pathophysiology and if you break it down like that in your mind you can think yes, I understand why". He makes the distinction between "it's easy to just memorise it" and understanding that "they're all interconnected".

Bailey identifies gaps in his learning throughout the four sessions of the case and then summarises and breaks down aspects of the case into inter-related concepts. He comments that it's easier after the four sessions "once you have a bigger picture of the case". However, his methods are focused on understanding at each step of the way, identifying gaps and then summarising the case to make sure he has understood fully.

Activation and Elaboration of Prior Knowledge

Bailey's process of learning is focused on understanding and connecting knowledge on an individual level. Bailey demonstrated this by the process he individually engages in to understand the diabetes mellitus case. In addition, from Bailey's description, a pattern is evident in that, in Session 1, he focuses on a broader base of knowledge that goes beyond what the specific problem in the case requires and, once satisfied that he has a broader understanding of other commonly related diseases, only then does he focus knowledge to the specific case. This represents elaboration on knowledge at an individual level. There is no evidence of Bailey engaging in elaboration within his PBL group. To the contrary, Bailey states he would be more productive spending the six hours of PBL tutorial time each week engaged in individual learning. This reflects Bailey's perspective of PBL tutorials: "a lot of the time things which are covered are things which you already know".

Group Collaborative Learning Versus Individual Knowledge Acquisition

In Bailey's case, there is evidence of more individual knowledge acquisition over group collaboration. Bailey is not influenced by the PBL group and believes a lot of other students incorrectly ascribe the depth of knowledge reached in the PBL group as the required knowledge level. Bailey's view of this knowledge level is different: "I have never had a PBL group that's gone into a lot of depth over things". This is further reinforced by his inattention during sessions, when the group discusses topics he already understands: "I may fail to concentrate for three-quarters of that time". He further asserts that other members from his peer group have reported they never learn anything from their PBL tutorial. He acknowledges that others say his "peer group is a bit too sort of diligent". However, Bailey astutely sums this up by saying "they [his peer group], like me, they guide their own way rather than taking the guidance of the other members of the group". There was no evidence that Bailey engaged in collaborative learning with his PBL group and preferred to learn individually and occasionally, when he had some difficulty understanding content he referred to his peers for relevant issues.

Cameron and Bailey: Comparative Epistemological Analysis

Cameron was one of lowest academically ranked students and Bailey one of the highest. The analysis showed that Cameron held naïve epistemological beliefs and Bailey held sophisticated epistemological beliefs.

Certainty of Knowledge

Cameron views knowledge as fixed and Bailey views knowledge as fluid. Cameron focused on "pulling" knowledge from different groups and friends and constantly looking for direction. His practice was to gather information, which suggests there is a fixed amount. In reference to "pulling all the information in", Cameron described that: "once you get it all together, it increases your understanding of the case". However, there was no evidence that he did understand the cases after two years. Whereas Bailey focused on understanding and integrating the "bigger picture" of the cases and understood that no knowledge existed in isolation. His approach was based on applying a broad scope of knowledge to current PBL cases and investigating other similar types of presentations before paring this down to any specific disease. This shows that Bailey understood that knowledge was fluid and could be modified in exchange with the information provided in the PBL case.

Simplicity of Knowledge

Cameron views knowledge as an accumulation of isolated facts which are not related. He refers to "loose facts" and "missed things" within the PBL process. He describes trying to pull all this information in trying to cover everything. In comparison, Bailey described knowledge as highly-related concepts. Similarly to Gordon, Bailey's focus was on *understanding* everything in the context of the PBL case, compared with making sure facts were *covered* for each case. Bailey demonstrated this with his reference to the diabetes mellitus case "if you have a good understanding of the pathophysiology…then you can understand why the treatment works" and stated that "it's easier to just memorise to give oral hypoglycemic agent", but then "you don't really understand the treatment too well. They're all interconnected".

Source of Knowledge

Cameron relied on his friends and PBL group as the source of knowledge. In Chapter 6, it was highlighted that Cameron was also dependent on his tutors. Cameron saw the source of knowledge as external. He referred to "the other students do the learning and not me". By comparison, Bailey did not rely on other students nor his PBL group. In addition, the absence of reference to tutors in Bailey's discussion was significant. This supports the view that Bailey was not dependent on external sources. However, Bailey did have a selective peer group but did not rely upon this source and described occasionally checking in with them if he had areas of concern. This was in contrast to Cameron, who was continually calling upon his peers and friends. Bailey was also critical of other students and groups, who "based all their work on discussions or objectives that are drawn from their PBL sessions", and described "never having a PBL group that's gone into a lot of depth". Bailey always went further than his group and spent the majority of his time constructing knowledge for himself using the PBL cases and selective textbooks.

Justification for Knowledge

Cameron was not able to justify knowledge for himself. What he usually does is "compare myself to a lot of my peers" and "just having a bit of chat, just a chat". He describes engaging in these chats just to "help me evaluate where I was going and see if I was doing the right thing". Cameron states there is variation between the different groups and tutors and what the learning issues are and, therefore, justifies that it's important to "talk with friends and find out what they did". This shows that Cameron *attempts* to evaluate his knowledge by observing others; however, towards the end of the interview, he revealed "Look at the end of the day…I've come this far so I must be doing something right". This shows that he justifies knowledge based on his feelings and not as a result of evaluating evidence in context.

In contrast, Bailey is able to evaluate evidence in context. Bailey evaluates his level of understanding in a variety of ways. He used the final PBL sessions to evaluate what aspects he may have understood and fills in any gaps. He uses textbooks to supplement his understanding. Bailey's use of textbooks is different from high school rote learning methods, and he describes specifically using them to understand the "inter-connectedness" of medicine. Bailey then applies these principles to understanding the diseases. Primarily, Bailey evaluates knowledge from his own self-examination of the depth and breadth of the PBL cases. Bailey is astute enough to cover beyond what is required for each PBL case. He explains that, if you just cover what is required, that gives you "a very specific knowledge in that disease" and doesn't give you the "broad knowledge which is required". This shows Bailey has very sophisticated beliefs in his justification of knowledge.

Summary of Cameron and Bailey

Cameron's description of working through a PBL case demonstrates that he has not moved beyond naïve epistemological beliefs. He views knowledge as fixed and simple and believes knowledge originates from others and was unable to evaluate his knowledge. By comparison, Bailey demonstrated sophisticated epistemological beliefs. However, in contrast to Gordon's experience, Bailey did not demonstrate the same sense of struggle in adjusting to the PBL process. There was no evidence of a shift in his development and therefore, in retrospect, it can only be inferred that Bailey may have held sophisticated epistemological beliefs from the start of medical school.

Jamie: Well obviously I know a little bit about it

Session 1: We have to make hypotheses based on the information as to what we think could be causing the problem. Often at that point you will sort of know whether you have the basic knowledge or not because if you have not one idea of what could be wrong with this person then you might want to look up the symptoms and signs. For example - gall stones - I sort of knew you could get gall stones but that's about all. I didn't really know what the stones were made up of or whatever and I didn't really know much about the gall bladder so then when I couldn't do the hypotheses I went for basic physiology of the gall bladder just to get a general understanding because I find it easier to work out what has gone wrong when I know what should be happening to start off with. After that I did the learning issues, which were more sort of focusing on specific symptoms or signs, like how can abdominal pain in the right upper quadrant be caused or what could be causing this pain so then - I did the physiology first so I sort of knew - and I did the relevant anatomy so I knew the duct arrangement and then tried to apply that into the learning issues and then I'd go and look in a pathophysiology book for those sorts of things and then hopefully put that all together and be able to answer the learning issue with a mechanism.

Session 2: We went through our learning issues and I thought things were going okay, like I might answer a learning issue, but then someone asked me a further question about it I wasn't able to answer that so I knew that I didn't really understand it even though I thought I did at the time. So then I went back over it and re-did it that night. We also got more sheets and because before we get given the sheets we have to say what we would expect to find or what sort of questions we'd be asking and why we would be asking those questions or what we would look for on physical exam and why and I found that I was able to - like I had read about some of these things last night or whatever so I sort of had an idea of what might be on the sheets before we got the sheets which then made it easier to think "Okay, well obviously I know a little bit about it then because I have some idea of what this next sheet is and what it's telling me." But then there were still more learning issues from that obviously. At home, I then went back to the learning issues that I couldn't explain during the session and read up on those again and then I went through the sheets to make sure I knew what it all meant and what it was telling me and then moved on to the learning issues. Some of that was about why things are significant or whatever.

Session 3: We refine our hypotheses based on the reading that we've done in our learning issues and stuff like that. That's helpful at just re-evaluating the information because again that tells us whether you know why things are significant or not because the tutor will say in a case – "What are your hypotheses and why is this your main hypothesis"? You through the past history and exam findings or whatever that support or discount that and I think if you can't do that then obviously you're not fully understanding the cause behind it. Then we'll do our learning issues again and if you can answer questions about them and explain it, like if you put a mechanism up generally then you'll talk it through to the rest of the group so if you talk it through and they ask you how you got from this step to that step and you can explain it then I think that is a pretty good sign that you understand what it is that you're putting up, whereas if you really have no idea you've got some more reading to do.

Session 4: Someone will do a case wrap-up which is good because they might bring up things that you haven't actually even considered so you might just jot them down and have a read. It's just finalising anything that wasn't quite complete during the sessions that we've gone and extra reading, so coming back to all the things we haven't had time to put up. Pretty much - there's a process and you start at the beginning and you end up at the same place every time.

PBL Process Analysis

Jamie's approach reflects her naïve epistemological beliefs, where knowledge is not inter-connected; her PBL group is the source of knowledge and she is unable to evaluate her own knowledge. For example, in Session 1, Jamie described focusing on specific learning issues which required her to learn basic anatomy and physiology. After this, she "sort of knew" the anatomy and then "tried to apply that into the learning issues", which will "hopefully pull that all together". This shows that she unable to inter-relate knowledge.

However, in Session 2, whereas Jamie described understanding something from her readings based on the learning issues, she was unable to answer a question in class. Then she explained: "I knew I didn't really understand it even though I thought I did at the time". In Session 2, Jamie uses the [PBL tutorial] sheets, which she says make it easier for her if she predicts what might be on them. She refers to "well obviously I know a little bit about it because I have some idea of what the next sheet is". Her pattern of prediction and checking and estimating whether she has "some sort of idea" demonstrates that her approach to PBL is governed by her naïve epistemological beliefs. This is further evidence that Jamie is unable to inter-relate knowledge.

In Sessions 3 and 4, Jamie talks through the mechanics of the PBL group process rather than demonstrating her individual approach. For example, Jamie talks as though she and the group are one entity. She explains in theory what should happen but does not refer to what she does individually. Jamie explains in more general terms that "we refine our hypotheses, based on the reading we've done on the learning issues and stuff like that". Jamie goes on further to add: "if you really have no idea you've got more reading to do". This demonstrates that, by the end of the fourth PBL session, Jamie is not able to inter-relate or evaluate knowledge.

Activation and Elaboration of Prior Knowledge

There is no evidence that Jamie engages in the activation and elaboration of prior knowledge with her PBL group. She refers to "not having one idea of what could be wrong with this person" and then focuses on specific symptoms to direct her reading. Jamie frequently refers to "reading" and describes reading some more when she does not come up with the right answers. This suggests

that Jamie's reading does not enable her to elaborate on her prior knowledge and apply it to the case at hand. Given Jamie's naïve beliefs, reading may indicate learning a fixed amount of knowledge without the ability to apply this knowledge in a more sophisticated way. Instead, Jamie tries to predict what may come up in a case as shown in her discussion about the PBL tutorial sheets. Jamie's reliance on prediction indicates she is not elaborating on knowledge in her approach to PBL.

Collaborative Learning versus Individual Knowledge Acquisition

It is difficult to characterise Jamie's approach as collaborative learning versus individual knowledge acquisition and, in some instances, neither is evident. For example, collaborative learning suggests that students learn together, and there is a sense of detachment in relation to Jamie's participation in the PBL process. Jamie depends on her PBL group and especially her friendship group to enable her to cope with the demands of medical school. However, there was little evidence of active engagement in collaboration with the group. Similarly, Jamie's focus on *reading* rather than *integrating* knowledge and her inability to understand what is required in between PBL sessions demonstrates she is unable to engage in individual knowledge construction.

Reese: I do a lot more to get the whole picture

For the first PBL session often just looking at the lectures for the following week you can tell what system it's even remotely related to, so I'll try and do just a bit of basic physiology reading, very basic textbook if it's something I've never done before. At the end of the first session you have your learning issues but the learning issues, because they are so specific –the learning issues are formulated as a question –so you literally go off and study and find the answer to the question. Often I find that it's not enough. I tend to do a lot more physiology reading, just background, to get the whole picture, so I always start with more physiology and then anatomy as well. Then I really get into the learning issues because I if I just answer the specific questions I never really would get into the guts of the case which would really just am kind of floating on the surface. That's actually a huge amount of work – that's ridiculous– if you do it properly, so I wouldn't have to be doing it the weekend once the case is finished.

Even coming back to a second session after having done physiology and anatomy, even if I've done heaps and heaps of work, I still feel I don't really know it enough to put it forward within the group but once I get to a third or fourth session where we're looking at more specific disease processes, then I feel that because that's something I can contribute. For example one learning issue might be you revise abdominal anatomy -and that's huge! What level are we talking at? You can just look basically, "Yes, it's five minutes on that" or you could spend five hours revising abdominal anatomy and it's just really broad, so you don't really know what you're doing until you bring it back to the group and see what everyone else has really done.

If I saw someone using a really advanced book, I used to think "Oh god, more study needed to be done", but I have just come to a point recently, I suppose, after having done three lots of exams now, I've realised that I don't need to be – say if we have a case on the gallbladder - I don't need to be off at the library getting books on advanced gallbladder pathophysiology for surgeons. You know what I mean? I think that's something I would have done previously, thinking "Yes, I'm doing the right thing", but it's just too much and you just can't. A lot of people still do that.

Normally the weekend after case I'll just make a list of catch-up things to do and I'll end up just going back and doing it all again by looking at what I've missed; what I should have done; what I just didn't understand at the time, and then add things in then as well. I'll just extract from it what I think are the basic vital parts and literally summarise the case into two or three pages. Once the case it's finished you realise that a lot of what you did was perhaps unnecessary and I just extract what I perceive as being the necessary things.

I find a lot of the mechanisms that we'll do in PBL- that I thought were very important at the time and I would have spent hours looking at the cellular mechanism of whatever –but once you're sitting in the exams you're thinking "'that wasn't necessary; it wasn't necessary to know all these random hypotheses for different diseases that haven't even been confirmed yet in cellular detail when all they really want is just the basic step by step path from A to B".

The whole PBL style exam concept was something just so new! But because it's not something foreign any more - now we know the layout and just seeing the depth of knowledge required - this semester, more than anything I've realised I don't need to be doing ridiculous amounts of detail. You need to have a broader understanding rather than too deep and specific.

Reese: PBL Process Analysis

Previously, Reese disclosed her struggles with the medical program and lack of understanding of the PBL process and spent "a year and half of hating PBL". In the face of this, Reese's approach to PBL changed substantially. Her approach is now governed by trying to "get the whole picture" of PBL and striving for a "broader understanding", rather than just addressing narrower specific learning issues in each case. Reese does this by reading more broadly on physiology and anatomy and goes beyond what is required of the learning issues. Her analogy is that otherwise she wouldn't "really get into the guts of the case" and would instead be "floating on the surface".

Therefore, Reese uses Session 1 to guide the breadth and depth of what is to follow in the PBL case, rather than just focus on specific learning issues. With the work required in her comprehensive approach, it is not until Session 3 or 4 when the group is looking at more specific disease processes, Reese says "that's something I can contribute". This may be related to Reese's shyness and her experience of being intimidated by dominant PBL group members. Similarly, Reese previously described her experience with a dysfunctional group and tutor, which led her to complete the case from start to finish on her own. Notwithstanding this, Reese's approach developed to focus firstly on understanding the basics of the physiology, anatomy, pathology, etc., understanding and applying this knowledge to the PBL case and "taking a more holistic approach instead of just diagnosis! diagnosis!"

Reese also used the time after the four sessions of the case to review "what I just didn't understand at the time" and summarises: "what I think are the basic vital parts". This demonstrates that Reese's overall approach to PBL from Session 1 to after Session 4 is overseen by a more holistic approach of understanding the case.

Activation and Elaboration of Prior Knowledge

Reese actively engaged in the process of activation and elaboration of prior knowledge on an individual basis. This was demonstrated by Reese's approach to PBL, which was characterised by her focus on establishing a broader level of knowledge which went beyond the case requirements and elaborating on this, rather than focus on the narrower learning issues identified from each of the PBL sessions. However, there was no evidence that Reese engaged in the

process of activation of prior knowledge and elaboration within her PBL group. Reese was distrustful of relying on the knowledge that others brought to the group. This may have resulted from previous dysfunctional groups, where she later found that information provided by some dominant students was incorrect.

Collaborative Learning Versus Individual Knowledge Acquisition

In Reese's case, there was no evidence of collaborative learning. Reese clearly outlined her individual approach to PBL by her extensive preparations early in the case. Even after these preparations, Reese described not being able to contribute to the group until the third session. This may be from a lack of confidence on Reese's part and not her actual level of knowledge. In Chapter 6, Reese described doing all the PBL cases individually on the weekend as a result of having a dysfunctional group and tutor. This affirms that, when the situation arose, Reese was able to acquire the knowledge individually and not collaboratively within PBL.

Jamie and Reese: Comparative Epistemological Analysis

Certainty of Knowledge

Jamie views knowledge as fixed and Reese views knowledge as fluid. Jamie's approach to PBL was focused on learning fixed amounts of basic anatomy to answer specific learning issues and to predict the information that might be on the next PBL sheet. Jamie continually brought the focus back to answering questions about specific learning issues. This demonstrates that she did not view knowledge as fluid.

By comparison, Reese deliberately did not focus on specific learning issues for specific diseases, but chose to focus on a broader base of knowledge. Reese engaged in this extensive knowledge gathering to prepare her for the broader range of other related diseases with similar signs and symptoms. In her learning, Reese went further than what was required for each PBL case. Her practice of examining additional related diseases and signs and symptoms demonstrated that Reese viewed knowledge as fluid and able to be modified in the context of the different PBL case presentations.

Simplicity of Knowledge

Jamie views knowledge as an accumulation of facts. In comparison, Reese realised that knowledge was all inter-connected. In her approach to PBL, Jamie's focus was on learning specific amounts of material to satisfy requirements of answering specific learning issues. There was no evidence of her ability to integrate this knowledge. Reese had a holistic approach to PBL and saw knowledge as inter-connected and focused on understanding in the context of each PBL case.

Source of Knowledge

Jamie's source of knowledge was external and Reese's was internal. Jamie depended on the authority of her PBL group and friends to direct her learning. By comparison, Reese had learned from past experience to not rely on her group. Reese constructed knowledge for herself in interaction with the requirements of the PBL case, mostly without the assistance of her PBL group process.

Comparing Reese and Jamie's approach particularly highlighted that Jamie is a spectator of knowledge within the PBL group and Reese has progressed to an active constructor of knowledge outside of the PBL group.

Justification for Knowledge

Jamie was not able to justify knowledge for herself. In particular, she attempts to evaluate her knowledge from observing others in the PBL group. By comparison, Reese does not evaluate her knowledge by observing others in the group, but justifies her knowledge based on her *own* level of understanding of each PBL case. Reese's evaluation of knowledge is similar to Bailey's approach. They both described going beyond what is required for each PBL case to give them the broad knowledge that is required instead of specific knowledge of a disease in one PBL case.

Jamie also refers to "sort of having an idea" frequently during her approach to PBL, which shows she is also basing her evaluation on what she feels is needed. Reese demonstrated the progress she had made in PBL by justifying her knowledge based on a hierarchy of textbooks, from case summaries and a holistic understanding of the case.

Summary of Jamie and Reese

Jamie's approach to PBL cases demonstrates she has not moved beyond naïve epistemological beliefs. She views knowledge as fixed and simple, believes knowledge originates from others in her PBL group, and is unable to justify her knowledge. Jamie's experience was similar to Cameron's. They are both dependent on their PBL group and view the functioning of this as their authority. Similarly, after almost two years in medical school, they both lack confidence in their ability.

By comparison, Reese demonstrated sophisticated epistemological beliefs. She views knowledge as fluid, inter-related, views herself as the source of knowledge and can justify her knowledge in context. Reese's experiences and development was similar to those described by Gordon. Reese reflected that it took almost 18 months for her to understand the PBL process. However, Gordon described understanding the PBL process by the end of the first semester of first year in medical school.

Beth: It depends on your group and what path they take

Session 1: Even though we don't know much we're fairly systematic about it and I find that we use the knowledge that we have already so we use what we already know, like our basic anatomy, and pathology, I guess bits of physiology, to start with - things like what organ systems may be involved and all that sort of thing. At this stage you are all kind of thrown in the deep end, but I think in these sessions I'd say the group works really well together. I find in the group that I'm in currently the first session is probably the most collaborative and I think it really shows people at their sort of base line level. I actually really enjoy session 1 because I find it uses more lateral thinking, not just turning out textbook sort of stuff. It's a very logical thinking type session without notes, so at that stage then you can have specific learning issues and from there you know exactly what you have to look at stemming from what you already know or obviously what you don't know. At the end of the session going away to do my own work, I'd say I'm pretty clear-you can see that from what sort of learning issues - you can see what you already know and what you need to cover because it's usually pretty clear. Because also in session 1 you start off doing basic cut-off hypotheses and mechanisms and you try to flesh some stuff out but often it's pretty basic.

The first session we have usually relate to anatomy, to physiology, so I really try and get an understanding of the organ itself and the physiology of the system and usually I try to do as much of that as I can but also start looking at some of the pathological things that are relevant to this case. So I guess, after this first session I really just try to start getting a basic understanding of what's going on. Also at this stage so I find often some of the learning issues are quite expansive. There's lot of options and things you have to look at, that perhaps become relevant as you progress in the case. Also it depends on your group and what sort of path they take in that first session so often I find that there are certain learning issues that you might have that are more or less relevant.

Session 2: You've sort of I guess compared notes on your general understanding so far because that's what it's for – understanding of the organ system physiology. The discussion is helpful in working out what you already know and seeing how well you understand it. I find if you can explain it without notes then you obviously can understand it well. In terms of understanding everything the best indication of how I feel is in my head. At this stage there's often streams of information and you don't know specifically how much detail but often I find with note-taking - I probably take extra notes than you need - and then when I come back to it later, for exams or whatever, that depending on what happens and what we decide about the case, and having access to the case objectives, that I've really cut down on the information that I had and really just focus on general understanding. So I guess that's session 2, and usually you go away with fairly solid ideas about what you're looking at in the pathology and any sort of further investigations or that sort of thing.

Session 3: You've cover the majority of pathology and management, and especially with management our tutor can tell us how we're going because she'll - our current tutor - will place a lot of emphasis on this and I think a lot of the tutors don't specify where we're at until after were cleared up the tests and management. She's told us that she thinks often we're deficient in this area, I think because second year

is the first year that we've been seriously looking at management. I think we're all scrambling for resources - looking all over the place and perhaps trying, at times it's a bit difficult to get the right either specific or general information.

Session 4: I find our group is often not that productive because I think usually by the end of session 3 we've covered everything? It's like final management and just clarifying any issues and often people ask questions. I usually feel I've covered everything by session 4 but sometimes I find that there are things I have to finish up, usually my resource type things. I've got the general context but it's the really detailed things. One thing I find that's really bad with the way it's set out is often we start PBL before we have a resource session and it's anatomy and this sort of stuff that you need before you come to this and so you end up doing it for PBL when you need to do it for resource anyway and I don't like doubling up so I try and I guess do it in the most time efficient way. After session 4 usually there's a few holes so at the end I'm usually tying up loose ends and fixing up any theme questions I would like to ask. With resources, I think - you have to have done a basic amount of it to be able to do the case. I want to keep up with the case and I don't usually get too caught up on all the really small fine details in resource and often I find when I'm doing this that helps me go through the case and sum it up in my mind and just fill in the gaps a bit at that stage so I guess that's basically how I do it.

PBL Process Analysis

Beth's approach to PBL is centred on her expectations of the role and function of the PBL group and the process of collaboration within that setting. She depends on the effective functioning of the group and its collaboration. For example, in Session 1, she describes "we use the knowledge we already have" because "we are all kind of thrown in the deep end", and "in these sessions I'd say the group works really well". This also demonstrates that Beth is engaging in the process of activation of prior knowledge with the group. At the end of this session, Beth is confident of "what you already know and what you need to cover because it's usually pretty clear…often it's pretty basic".

Beth's focus in Session 2 is comparing notes on general understanding and working out whether she has understood the discussion. The best indication for her understanding is "how I feel in my head". In addition, she refers to taking lots of notes which she may later find were extraneous to requirements. By the end of Session 2, however, Beth concludes that "you usually go away with fairly solid ideas about what you're looking at". Although clear about what she is looking for, Beth does not discuss inter-relating and connecting knowledge.

By Session 3, Beth judges that the group has covered the majority of pathology and management. Again, she refers to the group as a whole and not to her individual progress within it. For example, in relation to clinical management of the patient, she describes “we’re all scrambling for resources” and asserts the whole group has difficulty. She justifies “it’s difficult to get the right specific or general information”. This demonstrates that Beth is focused on finding specific information rather than inter-relating knowledge.

Beth finds the group “is often not that productive” in Session 4, as “by the end of Session 3 we’ve covered everything”. This further demonstrates that Beth focuses on *covering* information rather than inter-relating knowledge. After Session 4, she is “usually typing up loose ends and fixing up any theme questions”. This suggests that she is not assessing understanding of the case at each step of the way.

Activation and Elaboration of Prior Knowledge

There is evidence that Beth uses the group process for activation of prior knowledge. However, there is no evidence that Beth elaborates on her knowledge within the group. Instead, Beth continues to compare her level of knowledge with others in the group to determine which learning issues to focus on and, therefore, is not building upon her knowledge. In particular, Beth uses the language of *covering* things in the group, as opposed to language indicating understanding and integrating knowledge. For example, when discussing assessing the understanding of a case, Beth’s describes “the best indication of how I feel is in my head”.

Group Collaborative Learning Versus Individual Knowledge Acquisition

Previously, in Beth’s narrative, she described the detrimental impact of dysfunctional PBL groups. Her elaboration on this theme highlighted her dependence on group collaboration versus individual knowledge acquisition. This supports the argument that Beth’s approach to PBL is centred on her expectations of the role and function of the PBL group and the process of collaboration. This was evident in all PBL sessions. For example, beginning from Session 1, where Beth says “it depends on your group and what path they take”, to the last session, where “the group is often not that productive”.

Catherine: Do I understand all of that?

Session 1: At the start of the case I have a goal and by the end of the case I've got to get there somehow. This is how I'll explain it to you. So as I'm going along we'll have session 1 and this allows me to identify what I don't know, because it will obviously be a new topic or something new to me. From session 1 I'll be able to make a judgment as to what my goal may be and I'll also be given a list of learning issues. So I'll go home and then it'll be study preparation time. This is when my learning issues will come into my private study and from my private study I'll hopefully cover all the learning issues that I want to cover. I'll also include in my private study – because usually learning issues don't involve what to predict and I'll always try and predict what's going to be in the next session so that I have a head start - so I do further research, so hopefully I'm learning for the next session.

Session 2: Basically I've got what my friends have inputted and what the lectures have given me and I've kind of prepared for session 2. So session 2 I'll get my learning issues and I'll also be able to find out going through what we discussed within the group and what we get in the sheets, how well I know everything. If I'm able to look at what's in the sheets and I understand most of it, then I think yes, I'm doing okay. If my friends - like once we're going through the learning issues - if I can understand what they're saying and everything like that, its fine. So I kind of self-assess myself at that point there. So do I understand all of that? Yes, I do.

In knowing that I've understood something, I read it and basically if I can understand why a certain part of the care is the way it is – so say if I think a person has appendicitis, in the physical exam – if I read about appendicitis and I know my stuff, I'd know that in the physical exam there'd be rebound tenderness. So if I go into this and read it and it says rebound tenderness, I can understand it, I'm like its sweet, it's all good. So do I understand everything like that? Yes or no? If it's yes, then that's fine, it's okay. If it's no, then I've really got to do it in my private study I've got to do catch-up for what I think I don't know. I do a lot of catch-up to make sure that I understand it all, because if you get behind then – a bit of advice don't ever get behind -be able to stay on top of everything. After private study would be catch-up, then the learning issues etcetera, then that would go on to bring me into session 3. Session 3: Will kind of be the same sort of thing. So for each session for me I'm bringing in the input from what my friends know, from what I've learnt from the lectures, and what my study's been. So I'll go into each session, then I'll self-assess myself in each session. Do I understand everything? If I do, that's fine. If I don't, then it's got to be catch-up for me and all of that, so that's etcetera, etcetera, and then hopefully I get to my goal.

Session 4: We come up with the case objectives. That's a good way of helping me self-assess because the tutors don't actually give out the objectives, we have to try and guess them, so if you can guess them all then that's cool, but if you can't get them all then you obviously – I haven't done what they want me to do. Why didn't I get that? I have to look back. I have to study harder. At the end, if we haven't guessed all of them the tutor will say whatever ones we've missed, but most of the time we do get them all, so that's pretty good, so we were on the right track.

PBL Process Analysis

Catherine demonstrates a very systematic approach to PBL and begins by outlining that she has a goal to achieve by the end of the four PBL sessions. Previously, we witnessed Catherine's need to be organised was evident in how she managed part-time employment and working three times a week. In each of the four sessions, she self-assesses her understanding along the way and strategy of catching up: "private study, catch up and learning issues...I get to my goal".

In Session 1, Catherine's approach is (depending on the information presented in the session) to "make a judgment as to what my goal will be". Once these goals are achieved and learning issues are understood, she does further research, including predicting what will come in the next session to "get a head start".

In session 2, again Catherine asks, "so, do I understand all of that? Yes, I do". The example of appendicitis and rebound tenderness is used to illustrate her thinking. Catherine describes utilising the input from many sources to help her understanding (i.e., lectures and friends) and, again, emphasises her system of private study, catch up and learning issues. Catherine describes a similar process in Session 3.

Session 4 for Catherine is assessing her knowledge against the case objectives. This is not just comparing what she had with the group in a passive manner. If Catherine didn't achieve all the objectives, she questions herself as to "why didn't I get that" and proceeds to study more on these aspects.

Activation and Elaboration of Prior Knowledge

Catherine's system includes activation of prior knowledge with her PBL group but elaborates mainly through individual effort during private study. Knowledge elaboration occurs through continual self-questioning every step of the way in the PBL process: "Did I understand it all?" This was demonstrated with her example of working through whether the person had appendicitis in the PBL case. If she doesn't understand then she says "I've really go to do it in my private study and I've got to do catch up for what I think I don't know". Therefore, activation of prior knowledge appears to stem from the PBL group process, but the emphasis placed on private study indicates that Catherine elaborates on knowledge in greater depth outside of the group.

Group Collaborative Learning Versus Individual Knowledge Acquisition

Catherine's learning results from both group collaboration and individual knowledge acquisition. She describes using the input from friends and the group. This was mainly shown in Catherine's narrative in Chapter 6 (page 129). The PBL group is very important to Catherine, who benefits from the motivational factors and believes the group needs to be enthusiastic to get anywhere.

When faced with the group last semester that was not enthused, Catherine was angry: “you guys are all taking what I say as gospel”. She described becoming exhausted with the process of coming up with all the information in the group. However, this demonstrated that Catherine could also engage with individual knowledge acquisition, as opposed to group collaborative learning only.

Catherine recognised when other students in the group need help and selflessly assists. She reflected it “benefits me as well doing all that learning business”. This is the opposite of Gordon’s attitude of being “held back and slowed down” by others in the group. Similar to Reese, Catherine described hating PBL from the start. Now she can’t imagine learning without the PBL process.

Beth and Catherine: Comparative Epistemological Analysis

Certainty of Knowledge

Beth views knowledge as fixed and Catherine views knowledge as more fluid. Beth describes “we’re all scrambling for resources” for the PBL cases and trying to “get the right either specific or general information”. Additionally, Beth describes focusing on specific learning issues so “you know exactly what you have to look at”. This suggests Beth views knowledge as more fixed than fluid and was basing her approach in PBL on a shorter term view of finding specific amounts of information to take from one PBL session to the next.

In comparison, Catherine’s approach to PBL was focused on a longer term goal of achieving the objectives of each PBL case over the course of the four sessions. Catherine described assessing whether her knowledge was comprehensive enough at each session *and* for the following sessions. This demonstrates Catherine did not interpret knowledge to be fixed and understood the fluidity of knowledge as it developed over the duration of the case. Her approach was long rather than short term.

Simplicity of Knowledge

Beth views knowledge as an accumulation of facts and Catherine views knowledge as highly inter-related concepts. In her approach to PBL, Catherine focuses on the concepts presented in the PBL cases and assessing where knowledge in each case fits to understand it in context. Her explanation of the physical examination showing rebound tenderness highlighted the inter-related concepts of learning about appendicitis. This supports Catherine’s views of knowledge as complex.

In comparison, Beth refers to "what you need to cover" in each of the sessions, which suggests she focuses on accumulating facts in the PBL process, as opposed to inter-relating knowledge. Beth also describes taking notes, which she later realises were excessive when compared with other students. The process of focusing on notes suggests that she sees knowledge as consisting of pieces of information and indicates that Beth had not progressed to viewing knowledge as inter-related concepts. In addition, she frequently uses the term 'basic' in descriptions of working through the PBL process. For example, "you have to have done a basic amount" to keep up with case and "you try and flesh some stuff out but often it's pretty basic". This confirms that because Beth views knowledge as isolated pieces of knowledge, she is unable to inter-related knowledge in the PBL case and, therefore, continues to accumulate facts. This directly contrasts with Catherine's goal of understanding and integrating concepts in the PBL case over the longer term and not by Beth's case-by-case coverage of basic knowledge.

Source of Knowledge

Beth's source of knowledge was external and Catherine's was internal. The level of self-confidence Beth exuded could potentially mask the process of narrative analysis. For example, Beth refers to "not wanting to look stupid" and focuses on "saving face" in the PBL group. This is the opposite of statements from Beth's narrative, where she described "I really know where I'm at" and "being so reliant I just believe myself that I can do". However, in PBL, Beth volunteered that the path the sessions take "all depends on your group" and "what happens when *we* decide about the case". Beth's reliance on the group demonstrates that her source of knowledge is more external than internal, as she professes. This is further substantiated by the stance Beth displayed in her narrative of being dependent on the external authority of her tutors.

In the opposite of this situation, Catherine described an experience where other students look to her as their *source of authority.* In her narrative, Catherine described taking on the responsibility for looking up all the learning issues and contributing these to the group, as others in the group were not participating in the PBL process. As a result, the group continually looked to Catherine as a source of authority in that group. Therefore, Beth and Catherine's experiences sharply contrasted, with Beth looking externally for her source of knowledge whereas Catherine developed an ever greater reliance on her ability to construct knowledge for herself due to the circumstances of her group.

Justification for Knowledge

In Beth's approach to a PBL case, she was not able to justify knowledge and tries to evaluate knowledge by comparing herself with others in her PBL group. She describes "you are all thrown in the deep end", which suggests that she and others are struggling with the PBL process. By

comparison, Catherine describes continual engagement in a process of self-examination each step of the way in the PBL process. Catherine's own overall understanding of the PBL case is evaluated on the goals she set. Catherine emphatically used all tools in the PBL process. For example, her knowledge is based on understanding of the case objectives, input from peers, and the content of specialist lectures.

Summary of Beth and Catherine

Despite Beth's assertions regarding her ability, Beth's approach to PBL cases demonstrated naïve epistemological beliefs. She views knowledge as fixed and simple, believes knowledge originates from tutors and peers in the PBL group, and is unable to justify her knowledge.

Beth's language during her explanation of working through the PBL process focused on use of the word 'we', which refers to the collective of the group. This is similar to David's description of the process, which was also on the naïve level of this dimension. However, in contrast, David did not display the same level of confidence in his ability as described by Beth.

Catherine demonstrated sophisticated epistemological beliefs and views knowledge as fluid and inter-related, views herself as the source of knowledge, and can justify knowledge in context. Catherine's experience was very similar to Reese's recollections of managing with a PBL group that was not functioning as intended by the PBL process. Catherine, like Reese, constructed knowledge for herself, partly as a result of the impact of a dysfunctional PBL group process.

Chapter Summary

The results demonstrated that students' epistemological beliefs were the main determinant of their approach to learning within the PBL program. There is evidence that students' engagement in and approach to the program, including their individual interpretations of the role of the tutors, their role as learners, and the nature of the academic task, was determined by the epistemological beliefs they held and these was directly related to the process of learning. Furthermore, the lowest ranked students who held naïve epistemological beliefs misinterpreted the curriculum design and intent of the PBL program. These misconceptions were also directly related to their approach to learning, which was disabling. On the other hand, the highest ranked students, who held sophisticated beliefs, understood the cognitive complexity of the PBL program and their approach to learning was enabling.

CHAPTER 8: CONCLUSION

Introduction

This chapter discusses the results of the investigation into the personal epistemological beliefs held by medical students in their second year of a medical program with a PBL philosophy. There is a paucity of studies in the medical education literature on personal epistemological beliefs (Knight & Mattick, 2006) and Roex and Degryse (2007) strongly advocated "the need to introduce the concept of epistemological beliefs into medical education" (p. 616). Furthermore, the authors of a landmark review (Hofer & Pintrich, 1997) of personal epistemological theories claimed "we know little about the development progression of epistemological theories across educational settings and what the epistemological issues might be in individuals making the transition from…high school to college" (p.132). These authors recommended gathering naturalistic evidence in context as "these transitional periods provide opportunity to examine both individual cognitive- development factors as well as contextual opportunities and constraints that influence the development of personal epistemological theories" (p. 132). In addition, Hofer (2001) reported that there was little evidence for the four hypothesised dimensions of personal epistemological theories in context. All these aforementioned issues were addressed by the findings of this study. No previous research in medical education had taken a phenomenological approach in a naturalist setting, investigating the transition and adaptation by students to medical school, using the theoretical framework of personal epistemological theories.

Aims of this Study

The aims of this research were to investigate how epistemological beliefs were conceptualised by medical students at the end of their first two years in a PBL medical program; whether their beliefs evolved over the first two years, were related to the process of learning, and whether these beliefs differed between students from the lowest and highest ranked academic groups.

More specifically, these aims were re-stated as five questions:

1. What were the patterns of epistemological beliefs between the highest and lowest ranked students in this study?
2. How did students' epistemological beliefs evolve over the first two years?

3. What epistemological components in the educational environment that students experienced, made sense of, and were the most salient?
4. How were these epistemological components interpreted by the students within the four dimensions of personal epistemological beliefs?
5. How did the epistemological beliefs held by students relate to the process of problem-based-learning?

This study found evidence of all four of the hypothesised dimensions of personal epistemology, as proposed by Hofer and Pintrich (1997). These were identified both in the students' more traditional high school program and the constructivist medical program. A major finding to emerge was that the epistemological beliefs students held from their prior learning experience in high school played a significant role in their transition and adaptation to medical school. As outlined in the procedure of analysis section in Chapter 3 (page 666), a number of themes emerged from the data which were equally valid for further development. However, the fundamental differences that existed between the highest and lowest academic ranked students were best served by the application of and analysis by the theories of personal epistemology.

Furthermore, this study identified a significant relationship between the cognitive constructivist approach to PBL proposed by Schmidt et al. (2011) and the theoretical constructs of personal epistemology by Hofer and Pintrich (1997). These findings suggest that the curriculum design in medical school was a major influence on the development of students' epistemological views. Therefore, a main argument of this study is that a constructivist PBL medical program can help to accelerate students' epistemological development.

Framework for the Discussion

The discussion will focus on the epistemological path of students in the first two years of medical school and will address the aims, questions and additional findings. Firstly, however, it is important to initially reflect on why students struggle with the transition to medical school. Secondly, there is a discussion section on students' prior learning experience in high school. This analysis is important, as it reveals that students' interpretations of their learning at the different high schools they attended were indistinguishable. This juxtaposes with the differences in their interpretations of learning when they are in the same medical school. Thirdly, there is a summary of students' interpretations of their first semester in medical school. This is noteworthy as, from first semester onwards, the patterns of student learning diverge based on their personal epistemological beliefs.

Thereafter, the discussion focuses on addressing the five research questions of this study. For questions 3, 4 and 5, the findings are discussed under two headings: *Portrait of Naïve Learners*

and *Portrait of Sophisticated Learners*. In justifying this approach, the results chapters focused on the individual experience of students. Advancing from this individual perspective, this chapter focuses on the collective experiences of students who held epistemological beliefs from opposite ends of the four dimensions (i.e., naïve beliefs compared to sophisticated beliefs). These portraits are purposeful to contrast and emphasises the patterns that emerged in the epistemological beliefs between students from the lowest and highest academic ranked groups. These portraits highlight the major differences in students' interpretations within the *same* learning environment in medical school. Furthermore, they illustrate decisively that students' epistemological beliefs were a major determinant of their approach to learning. Schwab's (1978) Educational Framework (The Learner, The Teacher, The Subject Matter and the Learning Environment) is also used to elucidate the similarities and differences of interpretations between naïve and sophisticated learners.

Finally, the relationship between components in the cognitive constructivist approach to PBL proposed by Schmidt et al. (2011) and the theoretical constructs of personal epistemology by Hofer and Pintrich (1997) are discussed.

Why Students Struggle with the Transition

All students in the medical program participated in a rigorous selection process which assessed both their academic and personal attributes. Therefore, it could be assumed that each student was capable of adapting to the rigorous demands of the PBL medical program and could undertake a path to achieve this qualification. However, at the end of first year medicine and after a series of multi-disciplinary examinations designed to measure a range of knowledge and skills, there was evidence of a divergence of results within the students. Some students failed and others achieved a bare minimum pass. It is the students who achieve a minimum pass and retain their place in the medical school, but continue to struggle over the early years, which are of the most concern. By analysing and comparing the personal epistemological beliefs held by students who minimally pass with those who excelled in the program, this study found an epistemological explanation for why some students struggle, and will continue to struggle, based on their prevailing epistemological beliefs.

High School Was a Breeze

Students' prior learning experience in high school was instrumental to their beliefs about what knowing is, what knowledge is, and how they evaluate knowledge. This shaped their personal epistemological beliefs. The students unanimously described high school as easy and requiring little effort. This was evident for all the students, including those in the lower ranked group. Students depicted a high school curriculum which was delivered within a traditional pedagogical

philosophy. The epistemological components in the learning environment that were most salient for these students were the role of the teacher, the syllabus, textbooks and examinations. The curriculum design and the teaching and learning practices inherent in this design were analysed as representing the naïve dimensions of the certainty, simplicity, source, and justification of knowledge. The fixed boundaries of knowledge determined by the syllabus and the containment of this knowledge in prescribed textbooks were foundational to the beliefs about the Nature of Knowledge that the students interpreted from this learning environment. Similarly, the role of their teacher in transmitting knowledge to them, and the absence of the need to justify and evaluate their own knowledge, were foundational to their beliefs about the Nature of Knowing.

In high school, students interpreted the role of their teacher as the giver of knowledge, and their own role as learner, as the receiver of knowledge. They interpreted the subject matter to be individual subjects based on a defined syllabus, with prescribed textbooks. The learning environment students described was traditional classroom based with one teacher for each subject who was the content expert. There was an absence of learning in groups, and Year 12 in particular was a competitive learning environment where students had to surpass their peers to get into medical school.

The struggles that students experienced when transitioning from high school to medical school was due to their lack of experience in encountering a curriculum design that required more sophisticated levels of epistemological beliefs.

Medical School Was a Shock

Students described the transition to medical school as a shock. Most volunteered that they used their trusted and engrained high school methods of rote learning in first semester. However, these methods failed, as the nature of the academic tasks and the learning environment in medical school was substantially more complex than high school. The medical school curriculum delivered via a constructivist problem-based learning program was analysed in this study to require a sophisticated level of epistemological beliefs. This was in contrast to their high school pedagogy, which required a naïve level of epistemological beliefs. As a consequence, in the first semester of medical school, students described a fundamental shift in all four elements of Schwab's Educational Framework: the teacher, the learner, the subject matter and the environment. The epistemological components in the medical school learning environment that were most salient for these students were the role of their tutors, the peers, their own role as a learner, and the PBL process and functioning of the group. The role of peers was not a factor present or reported in their high school experience. In medical school, however, interaction with peers was integral to the PBL process.

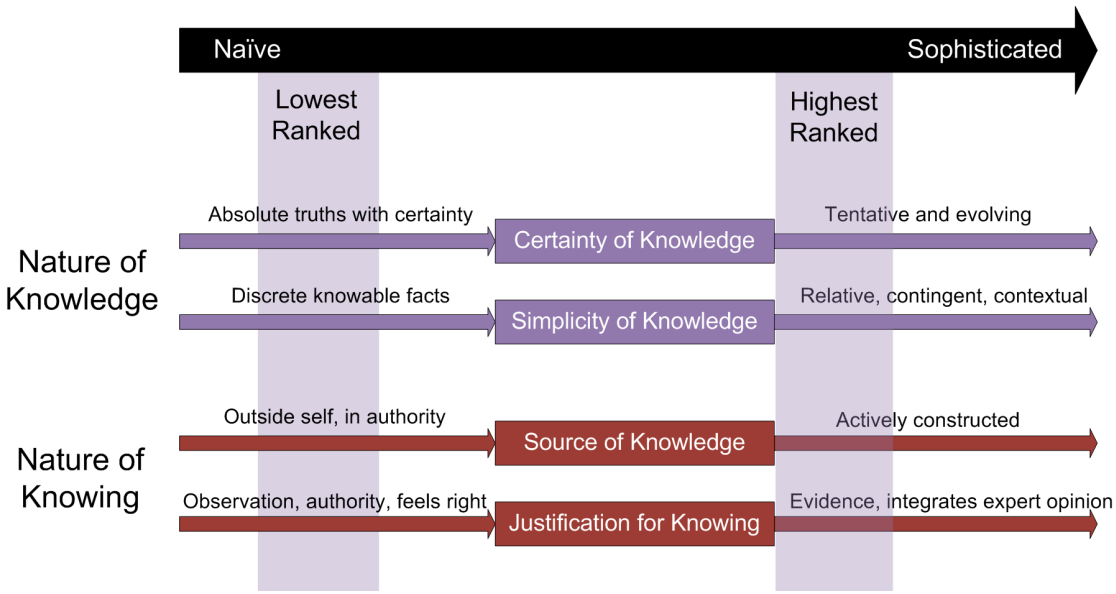

Figure 3 Epistemological Beliefs Representative of the Lowest and Highest Ranked Students

Addressing Research Question No. 1

What were the patterns of epistemological beliefs between the highest and lowest ranked students in this study?

There was evidence of a pattern within students based on the theoretical framework of personal epistemological beliefs. This pattern, without exception, revealed that students who demonstrated naïve epistemological beliefs in their approach to learning in medical school were in the lowest academic ranked group and students who demonstrated sophisticated beliefs were in the highest ranked group. This is represented diagrammatically in Figure 3. The shaded portions in the figure represent the epistemological beliefs of the lowest and highest ranked students.

The analysis from Chapters 6 and 7 demonstrated that David, Beth, Cameron and Jamie held naïve epistemological beliefs and were from the lowest academically ranked group of students. In contrast, Gordon, Bailey, Catherine and Reese were analysed as holding sophisticated epistemological beliefs and were from the highest ranked group. These patterns were reflected in how students interpreted the roles and components of the learning and teaching practices, most notably, the role of their tutors, peers, their own role as a learner, and the PBL process and functioning of the group. Students interpreted these roles and components differently, depending on their experience and epistemological beliefs.

The epistemological components of the learning environment categorised into Schwab's framework provided evidence that students from these two groups interpreted these components in qualitatively different ways. Students from the lowest ranked group demonstrated dependence on the role of their PBL tutors, peers, the group process, and the role of specific learning issues

within each case. Students in this group expected a high degree of direction similar to what they experienced in high school and focused on covering the material they perceived was required to pass the end of year examinations. In contrast, the highest ranked students were not dependent upon their tutors, peers or the PBL process. They took responsibility for their own role as a learner and guided their way during the PBL process and extended their knowledge past the specific learning issues in pursuit of greater depth and breadth of knowledge that was expected over the longer term of studying medicine.

Addressing Research Question No. 2

How did students' epistemological beliefs evolve over the first two years?

There was evidence of development of students' epistemological beliefs over the course of two years of university education. All the previous research on epistemological development in university college students reported students did not undergo a shift towards more sophisticated epistemological beliefs until at least three years into their education (King & Kitchener, 1993). This study provides evidence that the high achieving group in this purposeful sample demonstrated a shift to more sophisticated epistemological beliefs within the first two years of their education. In this group of students, the time to shift varied and, for some students, occurred in the first year of medical school, while for others it took 18 months. One student in this group also demonstrated sophisticated beliefs from the beginning of medical school.

However, the other half of the sample, consisting of students from the lowest academically ranked, demonstrated that there was no evidence of a shift toward more sophisticated beliefs and they retained their naïve beliefs embedded from high school.

Each of the research studies of epistemology development, and the models that resulted from these, described that a fundamental shift was required for epistemological development of the individual (Baxter Magolda, 1992; Belenky et al., 1986; King & Kitchener, 1994; Perry, 1970). This shift was characterised across all models by openness to new interpretations of knowledge. These shifts were given different emphasis in each model, depending on which of the four dimensions (certainty, simplicity, source or justification) were the focus of the research. For example, the Epistemological Reflections Model by Baxter Magolda (1992) is focused primarily on the dimension of the Source of Knowledge. This model is particularly relevant to this study of medical students in the context of a medical program with a constructivist PBL philosophy and the model describes an e*volution of knowing.* This evolution is a fundamental shift in three areas: the role of the learner, the role of peers, and the role of the instructor. Individuals become their own source of knowledge and this, in turn, determines how they relate to their peers and instructors. Baxter Magolda summarises this as: "transitional knowers shifted from acquiring to understanding

knowledge…preferred evaluation focused on understanding rather than memorization, and used peers to explore different interpretations" (2004, p. 34). The shift was evident from the narratives of students from the highest academically ranked group, which, according to the analysis, also held sophisticated epistemological beliefs.

In summary, there was evidence the lowest ranked students remained at the following stages, perspectives or ways of knowing according to each of the Models of Epistemological Development summarised in Table 2 on page 22. These are: Dualism stage (Perry), Received Knowledge (Belenky et al.), Absolute Knowing (Baxter Magolda), and Pre-Reflective Thinking Stage (King & Kitchener). In contrast, there was evidence of a shift in epistemological development among the highest ranked students to the following; Relativism (Perry), Constructed Knowledge (Belenky et al.), Contextual Knowing (Baxter Magolda), and the Reflective Thinking Stage (King & Kitchener).

Addressing Research Question No. 3

What were the epistemological components in the educational environment that students experienced, made sense of, and were the most salient?

As discussed in the introduction, the results of research question 3 are reported under two headings: Portrait of Naïve Learners and Portrait of Sophisticated Learners. These portraits are the collective experiences of students who held epistemological beliefs from opposite points of the four dimensions of personal epistemology. They also highlight the major differences in students' interpretations within the same learning environment in medical school. This experience reflects the last published work of Perry (1971) titled *Different Worlds in the Same Classroom,* where he described the extreme variation of students' interpretations in the same university college program.

Prior to these portraits, the epistemological components of the medical program learning environment, according to Schwab's educational framework; Teacher, Learner, Subject Matter and Learning Environment, which were outlined in details in Chapters 5 and 6, are recapped briefly to assist reporting research questions 3 and 4.

- The Teacher: Primarily the PBL tutor in the role as facilitator of the PBL process.
- The Learner: Student-directed with both individual and collaborative learning.
- Subject Matter: Integrated subject matter delivered via PBL cases with lectures, laboratory resources and supplementary material designed to support the PBL case.
- Learning Environment: The main learning environment is the PBL tutorial rooms. The others include lecture theatres, clinical skills laboratories, and hospital placements. In this

study, the learning environment extends beyond the physical learning environment to encompass the process of PBL.

Portrait of Naïve Learners

The components in the educational environment that were of most epistemological significance to naïve learners were: the role they expected from their tutors, the role of their peers, their beliefs about their own role as learners, their interpretations of the purpose of PBL cases, and their interpretations of their role with a PBL group. These students also placed greater emphasis on the role of the learning issues from each PBL case and the role of examinations.

For many naïve learners, the primary epistemological factor was the role of the PBL tutor in relation to the high expectations that were placed on this role in terms of providing guidance and direction, similar to the role of the teachers at high school. This was followed by the role of peers within the PBL process, which was viewed as secondary when the students were unable to rely on their tutors. The tutor's role was often misinterpreted by the students and this demonstrated a lack of understanding and engagement in the constructivist medical program with a PBL philosophy. For example, when students were struggling with the transition to the medical program they often focused on and blame the particular content and structure of a PBL case and associated learning issues and objectives, coupled with what they describe as a dysfunctional tutor and group. Overall, students in this category described the factors of epistemological significance in a negative manner.

Portrait of Sophisticated Learners

In essence, sophisticated learners identify similar components to the naïve learners, but these are interpreted in a positive, rather than negative, manner. For example, in relation to their role as a learner, students in this category welcomed and took responsibility for this role in their new learning environment. Some were not unduly affected by any components (i.e., PBL tutors, cases, peers, exams), while others, who had experienced dysfunction and discord within the roles of the tutor and PBL groups, ultimately described how these were instrumental to their development from a naïve to sophisticated perspective.

However, one important epistemological difference in this group, compared with the naïve learners, was the inclusion of the importance of the integrated nature of knowledge in the PBL cases. Students demonstrated this aspect fostered their epistemological development. They used the guidance of the overall learning objectives and case wrap-up sessions to assist them towards their goal of understanding and integrating knowledge in context, in contrast to the naïve learners who described basically collecting and rote learning the material.

Addressing Research Question No. 4

How were these epistemological components interpreted by the students within the four dimensions of personal epistemological beliefs?

In Chapter 6, it was reported that David, Beth, Cameron and Jamie were from the lowest academically ranked students and their analyses showed they held naïve epistemological beliefs. Gordon, Bailey, Catherine and Reese were from the highest academically ranked students and showed more sophisticated beliefs by the end of their second year in the medical program. This section summarises how the epistemological components within the medical program were interpreted by these two groups of students within the four dimensions of personal epistemological theory. Where relevant, there is also a brief reference made to a link between the elements in Schwab's educational framework: Teacher, Learner, Subject Matter and Learning Environment.

Portrait of Naïve Learners

Students with naïve beliefs appeared to misinterpret the design of the constructivist PBL medical program and the epistemological components within that learning environment. The difficulties they encountered were present in all of the four dimensions of personal epistemology. In particular, naïve students struggled with the dimension of the Source of Knowledge. The more traditional and didactic roles of the Teacher, Subject Matter and Learning Environment in high school contributed to these students' inability to transition to the role of the Learner expected in a constructivist medical curriculum. Students struggled with the nature of the academic tasks in the medical program where they were required to take responsibility for their own learning.

Certainty of Knowledge

This construct is also related to the Subject Matter in Schwab's framework. Students who hold naïve epistemological beliefs view knowledge as fixed and not as fluid and changing in interaction with the learning environment. Therefore, they interpreted the main role of the learning process was "covering stuff" in the PBL cases and "pulling all the information in" from other students and other groups to assure themselves they had covered what they perceived was the required amount. These students focused on finding the specific answer to each learning issue within a PBL case, rather than on understanding the breadth and depth of any issue. This is characteristics of a short term approach of finding the right amounts of information to take from one PBL session to the next. They were unable to see the longer term implications of knowledge which is fluid and contextual. Furthermore, they described collectively "scrambling for resources to get the right either specific or general information". Overall, their interpretation of the process of

learning within the PBL process was “covering all the material” and to “know exactly what you have to look at” in each PBL case.

Simplicity of Knowledge

This construct is also related to the Subject Matter in Schwab’s framework. Students with naïve beliefs refer to knowledge as an accumulation of isolated facts. This dimension overlaps with the certainty of knowledge, but is more complex because there is no recognition by these students that knowledge can be inter-connected. Therefore, this explains, in this context, why these students focus on learning specific amounts of material to satisfy the requirements of answering specific learning issues, which was a consequence of the fact that they had naïve epistemological beliefs and did not realise the inter-connection of knowledge. Therefore, they continued their focus on working out the basic amount of “what you need to cover” with regards to the information within the PBL case. They were unable to understand and integrate concepts in the PBL case due to their naïve beliefs that knowledge consisting of isolated pieces of knowledge required to be “covered” within each PBL case.

Source of Knowledge

This dimension is strongly linked to the roles of Learner and Teacher in Schwab’s framework. Students who held naïve beliefs were unable to view themselves as the source of knowledge and to construct the meaning of knowledge for themselves in the PBL environment. They were unable to progress from their role as a learner in high school to taking more responsibility in the medical program. In addition, they misinterpreted the role of their tutors. They expected a large degree of guidance and direction from their tutors and, when this was lacking, deferred to peers in their PBL group or friends to provide the source of knowledge. They viewed the source of knowledge as external and residing in others. In particular, they depended on the collective authority of their PBL groups as the source and transmitter of information to enable them to cover the essential material for each PBL case. These students also interpreted that the path each PBL case takes “depends on your group”, which demonstrates their source of knowledge is external rather than internal.

Justification of Knowledge

Similar to the Source of Knowledge, this dimension is strongly related to the roles of the Learner and Teacher in Schwab’s framework. Students often described being lost and without direction from teachers, as they were accustomed to in high school, and had little or no experience in evaluating knowledge for themselves, as this was not a skill they had engaged in at high school. Therefore, these students with naïve beliefs relied on their gut feelings and used other students in a similar position to them as a benchmark. They were unable to evaluate knowledge for

themselves and relied on what feels right for them to justify their approach. In the context of a PBL case, students frequently referred to things “just sort of fitting” and were dependent upon “what the group decides”. A large amount of time was devoted to checking in with their friends and other groups to see what “everybody else has covered” in their groups. This became of even greater importance when students were confronted with a large amount of variation between different groups and tutors on the matter of the learning issues within each case. These students lacked the ability to evaluate knowledge in context.

Portrait of Sophisticated Learners

Students with sophisticated beliefs interpreted the epistemological components as designed and intended by a constructivist medical program with a PBL philosophy. There is evidence this program fostered their epistemological development. Most students in this category struggled with the transition to this new constructivist program of learning over the first six to 18 months. However, in the longer term, the challenges they encountered in this learning environment resulted in a shift in their epistemological development towards more sophisticated levels in each of the four dimensions of personal epistemology.

Certainty of Knowledge

Students in this category progressed to interpreting knowledge as relative and modified in exchange with others in this learning environment. Rather than focusing on specific learning issues, as was the case of students with naïve beliefs, they focused on understanding and integrating the “bigger picture” of the cases and understood that no knowledge existed in isolation. Their approach was to apply a broader scope of knowledge to the current PBL cases and investigate other similar types of presentations before paring this knowledge down to one specific disease or case. This practice of more elaborate knowledge gathering prepared them for the wider scope of other related illnesses and diseases with similar signs and symptoms. These students described going far beyond the knowledge that was required for each PBL case, as they viewed knowledge as fluid and able to be modified in the context of different PBL case presentations. In general, these students focused on a longer term goal of learning for the requirements of the whole body of knowledge rather than the shorter term goals of students with naïve beliefs who engaged in achieving knowledge requirements akin to a PBL session-by-session approach.

Simplicity of Knowledge

Students with sophisticated beliefs focused on understanding and integrating concepts within each PBL case. Many described a shift from the didactic process of learning in high school to understanding everything in context, compared with covering isolated pieces of information.

Students recognised that, if you have an understanding of all the aspects of a particular disease, then you understood the treatment, as they are all inter-connected. These students demonstrated a more holistic approach to PBL and saw knowledge as inter-connected and focused on understanding in the context of each PBL case.

Source of Knowledge

This dimension is significant to the role of the Learner and Teacher in Schwab's framework. Students with sophisticated beliefs progressed to identifying themselves as the source of knowledge. They no longer depended solely on their teacher, tutor or other students. They had evolved to become active constructors of knowledge as a result of their interaction with the PBL environment. Many sophisticated learners did not raise the issue of the tutors or peers in their interviews, which reflects they were not dependent on external sources. This is in contrast to students with naïve beliefs, who recalled continually calling upon their peers and friends. Students with sophisticated beliefs recognised the risks of relying on other students in the PBL as their source of knowledge. In particular, they are critical of others who based all their work on "discussions or objectives that are drawn from their PBL sessions" and relay they've "never had a PBL group that's gone into a lot of depth". As a result of advancing to construct knowledge for themselves, these students describe going far beyond what is covered in their PBL group.

For some students, the experience of being in a dysfunctional group was instrumental in their development of sophisticated beliefs. For example, without the scaffolding of the PBL group and process, they worked through the case on an individual basis and became constructors of knowledge for themselves, rather than passive spectators within a dysfunctional group. In these situations, students developed greater reliance on their ability to construct knowledge for oneself due to the unintended consequences of the PBL environment.

Justification of Knowledge

Students with sophisticated beliefs progressed to evaluating evidence in the whole PBL environment and integrating those views with their own. They gathered evidence from a variety of sources and integrated the views of specialist lecturers and consultants. Most students in this category evaluated their performance in a variety of ways, compared with students with naïve epistemological beliefs, who did not understand the concept of justifying their knowledge.

Students with sophisticated beliefs use all the additional resources and are able to identify gaps in their learning. For example, they may use a hierarchy of textbooks, case objectives, case summaries and a holistic understanding of the case. Primarily, they evaluate their knowledge from self-examination of the depth and breadth of PBL cases. They are judicious and go beyond what is required for each PBL case to acquire the broad knowledge that is required, instead of

specific knowledge of a disease in one PBL case. They describe a continual engagement in a process of self-examination each step of the way in the PBL process, using all of the tools in the PBL process.

Addressing Research Question No.5

How did the epistemological beliefs held by students relate to the process of problem-based-learning?

There is evidence that students' epistemological beliefs were the main determinant of their approach to learning within the PBL medical program. The differences between students with naïve and sophisticated beliefs are summarised into the three areas of the Epistemological Reflections Model by Baxter Magolda (1992) which defines a fundament shift in epistemological development of the role of the learner, the role of peers, and the role of the instructor. This model, which focuses on the Source of Knowledge, is particularly relevant to highlight the results of this study and is outlined in Table 5 (page 34).

Portrait of Naïve Learners

The PBL philosophy of the medical program was well designed to facilitate epistemological development. However, these students were unable to progress to the turning point, which is inherent in the developmental models, and to construct knowledge for themselves in the medical program. Students who held naïve epistemological beliefs continued to approach learning in the PBL environment as passive spectators of knowledge and were highly influenced by factors from the affective domain of learning. Overall, based on their naïve epistemological beliefs, these students interpreted the context of the PBL program as disabling to their progress and as a constraint.

Role of Learner

Students in this group were unable to justify the source of knowledge for themselves. They copied what others were doing and focused on covering specific learning objectives from friends and other PBL groups. They attempted to compile learning issues and learn these without understanding them. They engaged in these practices as they were unable to evaluate the source and justification of knowledge for themselves, as they were passive spectators in the process and not active constructors of knowledge.

Role of Tutors

These students still expected a high degree of direction and support from their tutors. There was evidence they apportioned blame to individual PBL tutors, who the students felt were responsible for their individual progress in the PBL group, and on their final examination performance. This

dissatisfaction with the role of the tutors included their role in managing other group members and the overall functioning of the PBL group.

Role of Peers

These students were still dependent on the role of their peers for guidance on learning issues and the direction and outcome of each PBL case. In addition, they often referred to their peers as dysfunctional PBL group members who impeded their own progress in the PBL group.

Portrait of Sophisticated Learners

The PBL philosophy of the medical program fostered the epistemological development of these students. They approached learning in the PBL environment differently from naïve learners and became active constructors of knowledge for themselves. They were not as influenced by factors from the affective domain of learning. Overall, based on their epistemological beliefs, these students interpreted the context of the PBL program as enabling and as an opportunity for development.

Role of Learner

These students took responsibility for themselves as learners. They made the shift by the action of the knower moving from a passive spectator to an active constructor of meaning (King & Kitchener, 2004). The emphasis of learning within the PBL group facilitated this shift.

Role of Tutors

Students in this category either did not mention the tutors at all, are not unduly affected by their tutors, or, when they experience a dysfunctional tutor, they progress to working through the PBL case on an individual level. They were not dependent on direction from their tutors and often mention going far beyond what is covered in the PBL group.

Role of Peers

These students used peers in three main areas. Firstly, some students were frustrated by the lack of academic standards of their peers within the program and the PBL group and created their own select peer reference group. Some viewed peers who needed assistance as opportunities to further develop their own learning by explaining concepts to others in their PBL group. Others, who found themselves in situations when their peers were not participating in the PBL process, discounted working with peers and continued with the PBL cases on an individual basis.

Summary of Epistemological Beliefs Held by Students and Process of Learning

The results demonstrated that students' epistemological beliefs were the main determinant of their approach to learning within the PBL program. There is evidence that students' engagement in and approach to the program, including their individual interpretations of the role of the tutors, their role as learners, and the nature of the academic task, was determined by the epistemological beliefs they held and were directly related to the process of learning. Furthermore, students who held naïve epistemological beliefs misinterpreted the curriculum design and intent of the PBL program. These misconceptions were also related to their approach to learning which, as a consequence, was disabling. On the other hand, students who held sophisticated beliefs understood the cognitive complexity of the PBL program, and this was directly related to their approach to learning, which was enabling.

Cognitive Constructivist Approach to PBL and Personal Epistemology

This section argues there is a relationship between the components of the cognitive constructivist approach to PBL proposed by Schmidt et al. (2011) and outlined in the beginning of this chapter and the theoretical constructs of personal epistemology proposed by Hofer and Pintrich (1997). The main argument is that the complexity of the integrated knowledge in PBL cases and cognitive demands of a PBL curriculum, the PBL tutorial process and learning environment, required students to hold sophisticated epistemological beliefs. Figure 4 diagrammatically depicts the sophisticated levels of the nature of knowledge and knowing required for learning within the cognitive constructivist medical program. This contrasts with the naïve level of beliefs which were required in high school and shown in Figure 2 (page 978).

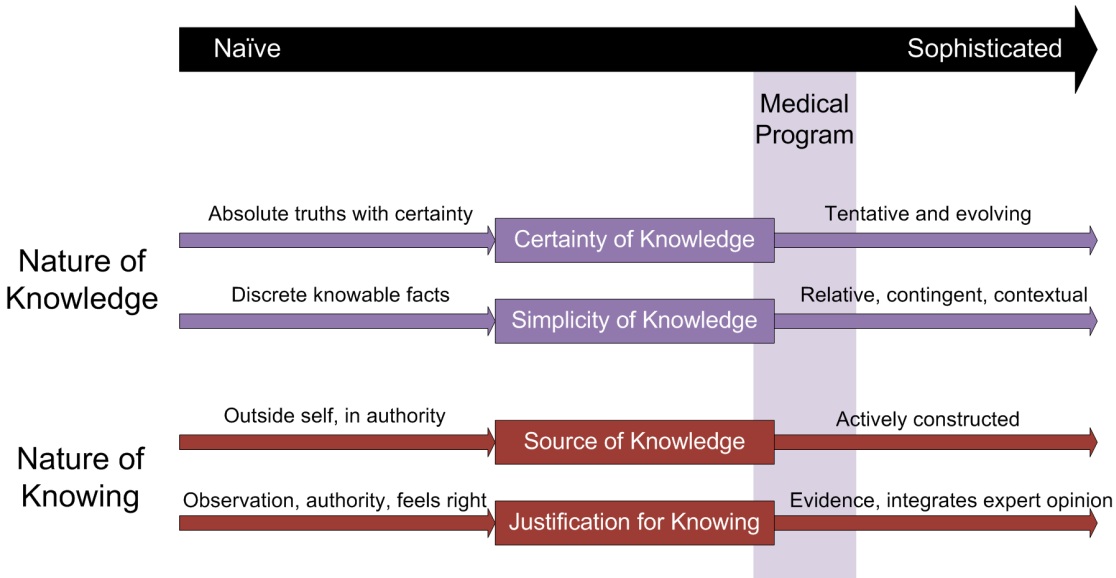

Figure 4 Sophisticated Epistemological Beliefs Representative of the Medical Program

The Activation-Elaboration Hypothesis and Certainty and Simplicity of Knowledge

In the context of PBL, students are presented with a PBL problem to activate their prior knowledge, which is then built upon in the group to explain the problem in terms of its underlying causal structure. Individuals then engage in private study on related issues and their knowledge is built upon in collaboration with the PBL group. The learners are described as being able to then identify gaps in their prior knowledge, leading to the activation-elaboration hypothesis (Schmidt et al., 2011).

This hypothesis is akin to the constructs of the sophisticated dimensions of the Certainty of Knowledge, where knowledge is viewed as fluid, relative, evolving and modified in exchange with others and the environment. It is also similar to the Simplicity of Knowledge, where knowledge is viewed as highly inter-related concepts which are relative, contingent and contextual.

In relation to the activation-elaboration hypothesis within the context of this study, the main argument is that the complexity of the integrated knowledge in PBL cases, the cognitive demands of a PBL curriculum, the PBL tutorial process and learning environment, in combination require students to hold sophisticated epistemological beliefs.

Group Collaborative, Individual Learning and the Source and Justification of Knowing

Schmidt et al. (2011) claim that "the extent of learning in PBL results from neither group collaboration nor individual acquisition only; both activities contribute equally in learning" (p. 792). This is akin to the constructs of the sophisticated level of the dimensions of the Source of Knowledge where individuals construct knowledge in interaction with the environment and the Justification of Knowledge where individuals evaluate evidence in context and can substantiate and critically evaluate this knowledge.

For example, in this study, students with sophisticated beliefs in the Source and Justification of Knowledge demonstrated they engaged in the cognitive constructivist approach of PBL. Thereby, they construct knowledge for themselves within the PBL process. They did not depend on the authority of the tutors nor were overly influenced by the behaviour of other students in their PBL group. There is evidence that some students with sophisticated beliefs were assisted by the group process but, overwhelmingly, they engaged in individual knowledge acquisition.

Summary

These findings show that students in the lowest ranked group, who demonstrated naïve epistemological beliefs after two years in medical school, misinterpreted the philosophy of a constructivist PBL program. As a consequence, their approach to learning in this environment was disabling and constrained. In contrast, students from the highest academically ranked group, who demonstrated sophisticated epistemological beliefs, interpreted the same program as

enabling. Importantly, these higher ranked students also experienced struggles in the transition period but successfully turned these constraints into opportunities for development. Significantly, most of the highest ranked students also described a fundamental shift in their approach to learning in the context of the constructivist PBL program.

These findings support that students interpreted their transition to the medical program as a constraint or an opportunity based on their personal epistemological beliefs. This contributes to answering one of the major questions posed by the key researchers in personal epistemological theories, Hofer and Pintrich, who recommended gathering naturalistic evidence in transitional periods, as these "provide opportunity to examine both individual cognitive development factors as well as contextual opportunities and constraints that influence the development of personal epistemological theories" (Hofer & Pintrich, 1997, p. 132)

The main argument is that a constructivist PBL medical program necessitates students who hold sophisticated beliefs about what knowing is, what knowledge is, and how they evaluate their knowledge. By the end of the second year in this environment, this study showed that the lowest ranked students still retained naïve epistemological beliefs. The patterns of learning that these students described was found to be disabling and constrained. This raises important questions in relation to the educational outcomes expected for these students at this second year level in preparation for the increasing clinical integration and content over the next four years. Firstly, have the students in this study with naïve epistemological beliefs sufficiently understood the requirement to integrate knowledge and to apply basic scientific knowledge to facilitate understanding and management of clinical practice? Secondly, do they have the capacity to recognise and accept limitations in their own knowledge?

Research Strengths and Limitations

There are a number of strengths and limitations to this study.

1. The research paradigm on which this study was designed provided a rich interpretative framework to capture the essence of each student's reality within a complex learning environment. This paradigm is recommended for further studies to address the questions 'why' and 'how' epistemological beliefs change and/or develop.
2. The construction of student narratives using their own words enabled a true and realistic account of the lived experience of medical students to be represented within a constrained word limit. The strength of this approach is balanced against the time-intensive nature of producing the richness of the narratives.
3. This study was completed with a school leaver student population transitioning to medical school, in one setting.

4. A small purposeful sample was selected and this limits the generalisability of the findings, although it provides in-depth understanding of the participant's epistemological beliefs.
5. There is still the potential for researcher bias; however, the process of recording and documenting the methodology has been provided to enable other researchers to apply this narrative approach.
6. The researcher was the primary instrument in the analysis; however, the data was triangulated to ensure the analysis and results represented the views of participants. This was achieved by progressively using three analytical techniques, namely, content, thematic and theoretical analysis.
7. If I were conducting this study again, I would followed the same research method and methodologies but collect the data from the students over a two-year period.

Recommendations from this Research

1. Students entering PBL curricula should be provided with a greater understanding of learning expectations of the program and how this may not coincide with an individual's epistemological beliefs.
2. PBL tutors should be trained to recognise the influence that a student's epistemological beliefs can have on their learning in the PBL setting. Tutor strategies will need to be developed to support student progression to become more sophisticated learners.
3. Curriculum designers should recognise that students entering tertiary studies have a set of epistemological beliefs embedded from high school and that the Year 1 transition phase should be designed to consider the range of learners from naïve through to sophisticated. Curriculum designers need to be aware of the disparity of epistemological beliefs held by medical students.
4. Early detection methods which consider the epistemological beliefs of students need to be developed to enable better support to be put in place earlier for students struggling at the beginning of medical school.
5. More emphasis during the transition year should be placed on the move from traditional classroom methods to a constructivist educational program.
6. More emphasis in tutorial delivery should be placed on the process of learning within the PBL group and the role of students in the group and the group dynamics to facilitate the process of epistemological development.

Recommendations for Further Research

1. Explore the personal epistemological perspectives of tutors who facilitate the PBL tutorial within the medical program, and how these beliefs may impact on the tutor's role.
2. Investigate a wider cross-section of students in a cohort to establish the range of beliefs on a continuum from naïve to sophisticated learners.
3. Explore the epistemological beliefs of students in more traditional higher education settings and the impact on their learning.
4. Investigate the personal epistemological perspectives of medical students in the context of their transition from study in the PBL case setting, to their first year in the clinical setting.
5. Investigate the personal epistemological perspectives of final year medical students in the context of their transition to their role of student internships in a professional context.
6. Investigate the epistemological beliefs of medical students entering a graduate medical program to establish the range of beliefs and their impact on the PBL learning environment.
7. Conduct a longitudinal study to investigate how epistemological beliefs change and/or develop from undergraduate to postgraduate medical training.
8. Conduct a follow-up retrospective study with the students from this study to capture their experience of progression through their final four years of medical school and transition to internship.
9. Investigate the responsibilities of medical educators for engaging and inducting students into the PBL process.

APPENDICES

Appendix A

Focus Group and Pilot Interview Questions

FOCUS GROUP

Now you are in the second semester of second year, can you tell me a little about how each of you thinks you are going?

What sort of things do you do for yourself that might tell you how you are going?

Can anyone discuss strategies that have worked out to help you do this?

Instead of waiting until the end of the semester for your exams, can you think back to ways you have been able to gauge how you are going?

Do these ways work well?

Can you discuss the impact of any feedback you receive?

Have you been able to identify gaps in your learning?

Do you have a sense of how you are going at this present stage?

What other things help you know?

Can people talk about how they learn to work out how they are doing in the clinical environment?

When you were on the wards, can anyone please tell me about the last time you took a history [clinical] and how did you know how you did?

PILOT INTERVIEWS

Do you think about how you decide what you need to review further?

How do you go about working out what needs to be done?

How do you work out what you don't understand?

When there is something that you don't understand, what do you do then?

When you have worked something out, how do you actually know for yourself how you know it?

How do you feel about your ability to be able to sit back and reflect and review what you know?

Given the practice you have had with PBL when you have a new case with completely new information [that you described as difficult] do you approach it differently now?

What type of things would make it better or do you just expect that it naturally gets harder as you go along?

Are you confident about the depth of your knowledge and do you have a way of working this out?

Appendix B

Student Introduction and Guided Interview Outline

PRE-INTERVIEW INTRODUCTION TO THE STUDENTS

I would like to work through with you, how you go about the process of reviewing what you have learnt. I hope to find out more about your ability to work out what you think you do and don't know and how you go about this, from an individual point of view. I know you have exams at the end of semester and year and you may get an indication from these results, but this research is more about how you, yourself, review what you are learning as you progress on a week by week basis. To help me understand this, I'll be asking about how you review and reflect on what you learn during PBL cases, in private study and your day in clinical skills. There is no right or wrong answers; I'm interested in how you go about working out what you know.

INTERVIEW GUIDE FOR THE FIRST INTERVIEW

AIM: To explore self-directed learning from perspective of student

How do you interpret the concept of self-directed learning?

How do you go about self-directing your learning (PBL, private study?)

How do you think you have adapted

How do you go about self-assessing what you do on a week by week basis?

What works best for you (what hinders you?)

What is it like trying to gauge your own performance?

What motivates you?

INTERVIEW GUIDE FOR THE SECOND INTERVIEW

AIM: To capture the 'think out loud' process of students working through a typical PBL case over the four PBL sessions and study in between.

Can you describe your process of thinking through your last PBL case?

How do you gauge your progress on a step by step basis during the case?

What influences your ability to self- assess?

What is your overall ability to self-assess?

How do you gauge your progress on week by week basis?

What motivates you?

Do you have any advice for a new student starting out after your experience?

Appendix C

Reese's First Narrative

In the beginning

When I first got here, I thought I was doing the right thing as I studied the International Baccalaureate so it's actually fairly similar in structure. So I thought I'd be prepared for the self-directed style of learning but found that it is very broad and very general and I find it really hard to kind of distinguish between what is necessary, what's unnecessary. I find that I can spend hours and hours doing something so finicky and small and be completely caught up in that and then realise it's not even relevant at all. I found I wasted most of last year doing a lot of work, a hell of a lot of work but to no end. I worked so hard and failed all my mid years just because - not because of a knowledge deficit but more so because of like a structural, how to structure answers and, yeah, the self-directed learning process kind of misunderstanding I think.

Struggle with the Process

I've struggled a lot with the process but have kind of gone back to basics and it's just taken me a lot longer to realise exactly *what the point of the process is*. It's generating hypotheses and things like that and taking a more kind of holistic approach to it instead of just diagnosis, diagnosis! But it's taken me until now to understand how everything ties in together so that you *get the clinical thing;* and just now I've been able to use what we do, like bring back good things to the PBL group and relate what we do in the group to what we do on our clinical days in the hospital and relate that, use both of those things as more of a guide as to what I need to go home and study privately myself. And yeah I just realised now it's all interconnecting.

Can depend on the PBL case

I think it depends as well on the case as well because a lot of the time it just doesn't seem to be very effective. Especially in the first couple of sessions it's hard to tell which direction the case is going to take and without knowing the objectives and not having anyone to kind of channel you in a certain direction. The tutor I've got now does that but previously in the first two sessions I'd say it's hard to focus on what is essentially the point of the case and so I find a lot of wasted time there looking into a lot of, when you get to the end of the case, you look back, a lot of random things you've looked into to try and get there; and that's a fairly general consensus and sometimes you just laugh about the things that you've spent time on and just wasted time on something so small or irrelevant that we didn't - it seemed relevant at the time.

Towards an Understanding

I worked so hard and failed all my mid years. I think she [staff member] looked back at my mid-year exam results actually and realised that I did poorly and that all my downfalls were more so in process rather than content - if that makes sense. So I saw her and she explained pretty much how to do hypotheses, things like that, because, yeah, it was as simple as that that I couldn't put on paper and that was holding me back from everything. So after that I was fine; I mean you have to adjust and just generate hypotheses in PBL as that's what they're looking for and now we just kind of do it systematically. Like these are the points and you begin hypotheses and yeah, so it kind of becomes systematic now; but yeah I think until I got the hang of the PBL process it was a lot of wasted time and didn't like it at all and yeah time to adjust and I did fine but it's really been from this year that I'm actually having a fresh start and yeah it's really made a difference from this year [second]. So it's literally taken me a full year to, in a sense, understand the process. It was more so the fact that we've had a year to get used to it and it's a very bizarre concept if you've never - yeah, but yeah realising from this year that a lot of information is irrelevant, just kind of focus on pretty much back to basics of physiology, anatomy physiology, pathology and yeah, kind of taking it back into, more systematic perhaps and realising that you don't need to go into incredible - that's the thing I've realised: you don't need to go into the incredible detail like I thought you needed, like every single step, cellular, chemical. I think a lot of us get caught up in that when it's perhaps not as important as other things.

The Dominant People!

I think the group dynamics change a lot of what you have to do. Our group, this time around, there are probably two fairly dominant people and I think that's a huge downfall with the PBL process. The way we're assessed on it is that its essential irrelevant how much work you do at home or how much knowledge you bring to the group. It's *whose got the guts essentially to stand up and say it*, and who is the first one in to jump up on the board and start writing and if - because I'm not the type of person that can just - I can't interrupt and I couldn't just jump up and start scribbling my thing down without asking everyone if they've got something better or to contribute. So I think yeah that's a huge downfall. There's a lot of imbalance and it's not as effective as it could be. I find in those situations I do more work at home to compensate for that. If the sessions don't go well or - I don't know how to say it - if the group isn't quite compatible and we are not rolling along then it does mean that you have to take that all and do it home what you should have done in the group perhaps. But it does create a lot of extra work, in a way and at the same time you're not really cross-checking as well. The thing that's almost annoying is the dominant people, just because they've got the authority perhaps in the way they speak, if they speak with confidence, nobody questions their content. Looking back over some of my notes now there are

mistakes and things we just wouldn't have questioned because you just almost assume the *people who put them up would* know and it must be correct and depending on who's in a group that really alters the functioning of the group.

Group Dynamics and Function

Often the tutors favour a little the people that speak - I think maybe there's the general assumption that “the more you say the more you know and the more you've done”, and often I think just looking around sometimes it's the people that say the least that might actually know the most or have done the most. I think it's not the easiest for them to stand up and I mean it is intimidating; it is, especially considering the different students, different backgrounds and different attitudes. Not everyone is compatible in the groups. It's tough to stand up there and do your thing when you know you're just kind of thinking we have got eight people sitting back, they must be criticising me. Yeah so especially if you've got one or two dominant people in the group then that just makes that all the more harder when if you start doing something and someone else might have might have done it in more detail or better or something like that. So I think that is a pretty big - because *I get really shy in those group situations; that's my personal thing,* I just automatically assume if I have got a mechanism or something I've done in front of me I assume everyone else must have the same thing or in more detail so I just won't even bother saying it. Then I think if the tutor thinks if you're not saying anything obviously you've done nothing. We are all here because we've worked; I don't think that's ever the case that someone's done nothing. I think often it's just to do with the dynamics; if the person feels comfortable enough, in saying "I've got this and let's look at this".

I’m going to fail

Everyone was convinced they were going to fail the mid-years [2nd year] and then we all got them back and we all did really well and "Oh, it can't be our exam". I think everyone is just always, always convinced that they don't know anything and they're going to fail. It's a huge problem. Even last year - because I live at one of the colleges, I live with about 15 second year med students and the night before one of the exams last year all 15 of us were up -it was about 4 a.m. the night before the exams. Everyone in tears on the phone to their parents "I'm coming home, I'm not going to finish the exam, I'm going to fail". It's pretty serious actually; somehow I think perhaps because there is not assessment all the way through like other courses or there is not really as much guidance through or maybe not enough feedback, but I don't think you have a huge amount to gauge yourself on, so of course *you just assume that you are doing the* worst and you assume that would be enough but I think there's always that feeling that - maybe it's just tied in with the actual course and the way it is that you can just never know everything and maybe it's part of that, or maybe it's just because it moves so fast. I know there's just that general

consensus that everyone's going to fail. Everyone thinks that, everyone's walking around thinking that.

Living with Other Med Students

Living with a lot of the other med students you really see some people literally at our level already only stop to sleep and eat and that's it. Like right now they're going to bed 3, 4 a.m. every day because they study. It's so hard when other people seem to just go out all the time and do nothing and you just think how much should I be doing, should I be somewhere in between or should I be going out; what sort of books should I be using? I think everyone is really gauging each other on each other and I don't think there seems to be a more authoritative way. It's not like high school where you know what you need to know, and I think that's probably the hardest thing with this is because you don't - because you don't know what you need to know. I think that's why we all thought we were all going to fail and that's why right now everyone assumes that they don't know enough because we don't know what is enough, if you know what I mean, and I think that's a huge thing. I think that also ties in with why you can spend hours and hours doing PBL and it doesn't actually help you because you don't know what enough for your level is. And we're given case objectives at the end of the case but even that's really kind of broad and, yeah, I think that is the biggest downfall is that there's no real - there's no concrete gauge for yourself as to know what's enough and how you are going until exams and that's why there's panic towards the exams. Like the exams last year, four people had breakdowns but it's purely because they don't - we didn't know what is enough.

I take a textbook to the Gym

How do I cope? I'm good now but last year we all just all lost it before exams. I just try and do a bit of sport but even so, it's just always - *I take a textbook to the gym* and things like that, because there's always that "I should be studying" because there are people that just study and eat and study and eat. You can never really escape that, like maybe it is because I'm at college so I see these people out of uni but you can never really escape it. Even just going out during the week I feel bad for doing that, just because I know that everyone else is back there studying and I should be doing that too and, yeah it's not - it sounds horrible actually when I think about it. Adelaide is my study place I just go home and leave it all behind here. I won't ever take a book home. It's just home's home and here is study. And yeah, I think for me personally, sometimes I really, really need to go home just go home for a weekend like catch the overnight bus or train, it is a bit hectic but just get out of here; especially living in a college you just can't escape it. You go to dinner and there's people studying at the table and it's in your face 24/7 and you can't get away from that and I think that does bring you down a bit.

Reflections on Learning

I've learned as a group. That's probably the primary factor. From other members of the PBL group, as in how much knowledge they bring to the sessions compared with the amount of knowledge I bring to a session and progress in terms of the knowledge you have and also in terms of the amount of work you should be doing. How much actual physical work they bring, like how many sheets, hand-written, or if they don't bring in anything at all. If your tutor kind of seems to limit your learning process I found it – in last semester I wasn't happy at all with the tutor. We found him really not doing what every other PBL group was doing, so I felt really disadvantaged, so I contacted friends in other groups and looked at their notes and did their learning issues. It creates a huge amount of extra work for yourself, but really if you want to get there in the end you've got no choice, so it's unlucky sometimes. The tutor– I'm sure he's a very intelligent person, but just not a PBL tutor -very focused on some things but not the bigger picture. So we covered a lot of things in absolutely minute detail and missed out on a lot of things and not really focus sometimes on big points in the cases. If you find that you've got a fairly open tutor that can see exactly how you are going and a tutor that acknowledges each of the members of the group individually, then that can be a really useful form of feedback. With my tutor last semester he wouldn't have known anything about me or my learning. The tutors do have their favourite students which are the ones that do put forth all the time and that isn't necessarily a reflection on knowledge levels. Louder students not necessarily most competent, if that makes sense.

When the whole group deviates

I also gauge my progress on the actual content of what we do in PBL. Sometimes if you haven't done enough work or the right work, you can sit in the PBL sessions and it just goes over your head and that's when you think "Uh-oh" but if I'm contributing and I'm understanding and being able to look at things and add to things that are already up there on the board, then I figure that I must be at the same level as everyone else so it must be okay kind of thing. So it's the actual academic standard within PBL, but then again a big problem with that is if your group's not on the right track and say *the whole group deviates, then not reliable*, I suppose.

Working out what the MEU [Medical Education Unit] wants!

What I find is a really good indication of how well I've understood a case is the case wrap-up session. The case wrap-up is a one hour lecture following the end of the case where they usually get the specialist on the subject to just talk about main issues in the case, go through the physiology, pathology. Often I'll use that to see if I should have done more. I find that fairly useful, because that's generic, that's the same for everybody, so you could assume that that's what the MEU, I suppose, wants you to know, *minus the variability of PBL groups*. But then again because that's at the end of the case, it's too late to go back and realise that you were sub-standard or you

should have put more work in at the time. Often, from the case wrap up, we develop learning objectives for the case. Often if the tutor's *kind* they'll give you an indication as to the learning objectives that were meant to be covered. In my group this time we were – not given word for word the learning objectives, I think they're not allowed to do that – but given a general gist of what the learning objectives are and compared with last semester where we weren't given any idea of the learning objectives at all, I think it's really beneficial to have that, because even if it's just a guide to what you should be doing and it doesn't give you a guide to how much depth you should be going into, but it gives you a guide of coverage.

Limitations of the Group

A limitation especially within the PBL group and tutor feedback, is that thing if you're a shy person or not comfortable with the group you're in then– and this does happen a lot – you don't feel confident enough to speak out, especially if there is a dominant group member, and I think you have a general understanding that shyness equals poorly prepared; haven't put the effort in; haven't done the work; if you're not speaking then obviously you haven't. And it's really tragic that people find ways, even if people haven't done any work, I mean, it's common knowledge if you haven't done your learning issues you just have to say one really profound thing at the beginning, even just suggesting a way we could approach summarising the learning issues, as long as you've said your one thing for the session they can tick you off that you've vocalised something and that's it. It seems to be more in a quantity thing rather than quality. Just the setup that talking equals knowledge. So if you're shy or not comfortable within group, talk less and that indicates that you're poorly prepared, don't really care or not keeping up when it might be the contrary. I think that's a bit of a vicious cycle then. Because everyone has their different roles within the group. There's definitely the stronger people and the quieter people and the type that jump between.

No escaping "What did your group do"?

I live in one of the residential colleges, so you don't really escape "What did your group do"? Then there's a bit of panic like "Oh my God, our group didn't do that, I'd better go and do that". I suppose it is an advantage in a way, compared to other people that might just be living at home and doing their own little thing but at the same time it perhaps makes you feel the panic and the constant guilt, thinking "I should be doing that, I should be doing more". I suppose that's something you have to really do off your own back, is you find out what other PBL groups are doing, what other people are doing to really gauge your progress in a more standardised way. The learning objectives kind of standardise everything as well. Things like the exams, they only ask us – it's only things that we've done before, so if you don't cover something in your PBL group, you don't know to do it by yourself and then that could be in the exam, that's a bit of a

worry to you, so you want to make sure you've done everything or looked at everything once before. At the same time you might be focusing on something completely irrelevant that we don't need to know until fifth year, or something, but you wouldn't know that if you weren't talking to other people, I found. Especially when you're with a tutor that the group doesn't seem to function very well with, that was really important. Last semester, when we found that our tutor just wasn't – it wasn't working well at all. At the end of each case I'd borrow friends' PBL group notes, people from other groups, and copy out all their mechanisms and all their learning issues and literally do the entire case again from the beginning over the weekend. So it was just a huge extra load of work to do, but it had to be done if I was to – otherwise I would have missed a lot of things.

I'm definitely a people person

If I didn't live in the college? I'd be struggling. And being a person that works well with people – I'm definitely a people person – if I didn't live in the college I think I'd be still studying in groups and talking to other people from different PBL groups because I find personally within the existing parameters of the members of my own PBL group and tutor feedback, I don't think that's enough, so I would still be talking to other students from other PBL groups and seeing what they're doing and finding out what I should be doing. The case wrap up helps but is more an explanation, more a lecture about the end result with the end diagnosis, so it's really useful for summarising what the case was eventually about, but it doesn't kind of take into account the process of getting there. The lectures we have along the way are good, just general lectures, but it's fairly rare that they seem to have – everyone's always saying that they need more lectures and people wouldn't mind coming in for more lectures because we seem to do that same work at home by ourselves and you can spend hours and hours looking in the book and then have *a* simple lecture on it with a brilliant lecturer and in one hour you can suddenly understand what you spent literally six hours doing the night before.

Appendix D

Reese's Second Narrative

Learning issues not enough to get into the guts of the case

For the first PBL session, often just looking at the lectures for the following week you can tell what system it's even remotely related to, so I'll try and do just a bit of basic physiology reading, very basic textbook if it's something I've never done before. At the end of the first session you have your learning issues but often I tend to find that learning issues, because they are so specific and that the way the learning issues are formulated, it's a question and you literally go off and study and find the answer to the question. Often If find that it's not enough. I tend to do a lot more physiology reading, just background, to get the whole picture, so I always start with more physiology and then anatomy as well. Then really go into the learning issues because a lot of the time they're more specific and I find that if I just answer the specific questions I never really would get into the guts of the case which would really just be kind of floating on the surface. That's actually a huge amount of – that's a ridiculous– if you do it properly, so I wouldn't have to be doing it the weekend once the case is finished. If I see someone using a really advanced book, looking at this sort of stuff, I think "Oh god, more study needed to be done", but I have just come to a point recently, I suppose, after having done three lots of exams now, I've realised that I don't need to be – if we have a case on the gallbladder I don't need to be off at the library getting books on advanced gallbladder pathophysiology for surgeons. You know what I mean? I think that's something I would have done previously, thinking "Yes, I'm doing the right thing", but it's just too much and you just can't. A lot of people still do that!

Broader knowledge is required rather than deep and specific

The first year mid-year exam was good to let us know how the exam structure worked but I don't think the first year mid-exam results were an accurate reflection of your progress, because the whole PBL style exam concept was something just so new. A lot of us didn't do well in that and I don't think it was a knowledge deficit, I think it was we'd never seen an exam like that before, but at the end of year exams last year and definitely the mid-year exam this year, because it's not something foreign any more. We know the layout and just seeing the depth of knowledge required was – yes, this semester more than anything I've realised I don't need to be doing ridiculous amounts of detail because it's just not going to be asked. Yes, I think that just shows that you need to be broad understanding rather than deep and specific. Even coming back to a second session after having done physiology and anatomy I still feel like I don't really know anything or even if I would have done heaps and heaps of work, I still feel I don't really know it enough to put it forward within the group, but once I get to a third or fourth session we're looking

at more specific disease processes, then I feel that because that's something kind of concrete that's okay. The learning issue might be you revise abdominal anatomy and that's huge. What level are we talking at? You can just look basically, "Yes, it's five minutes on that" or you could spend five hours revising abdominal anatomy and it's just really broad, yet you don't really know what you're doing or how much of what you're doing is correct, until you bring it back to the group and see what everyone else has really done, I suppose.

Once the case is finished you realise a lot was perhaps unnecessary

Normally the weekend after [the PBL case] I'll just make a list of catch-up things to do and I'll end up just going back and doing it all again by looking at what I've missed that I should have done, or that I just didn't understand at the time. I'll kind of summarise the case and just extract from it what I think are the basic vital parts and literally summarise the case into two or three pages, like cheat sheet style almost, and just try and extract from that the basics to hopefully then jog your memory about the details, because you do so much in a case you just can't learn all the details. You can't cram all the details. I'll then go back over it and if there's anything I've missed, then add things in then as well - just basic mechanisms. Even if I find a lot of the mechanisms that we'll do in PBL that I thought were very important at the time I would have spent hours looking at the cellular mechanism of whatever – even once you're sitting in the exams you're thinking "that wasn't necessary; it wasn't necessary to know all these random hypotheses for different diseases that haven't even been confirmed yet in cellular detail when all they really want is just the basic step by step path from A to B". I think looking back over a case once it's finished you realise that a lot of what you did was perhaps unnecessary and just extract what I perceive as being the necessary things and then summarise with that and then you've added exam revision.

You get back on the horse with a new PBL case!

A good motivation thing is the fact that a PBL case – I find this really good – if I don't quite click with one case, you know that it's only a week long and you can make a fresh start again and kind of get back on the horse. The fact that PBL cases are that, they're just cases, so if one you really just don't do well in you can always come back to it later and swot vac, just cram it or something. So if you find you're falling behind sometimes you just have to let go and think "No, just literally stuff it, I'll just start again, new case, new beginning, and keep up with the new case". The tutors are not very motivating because the tutors are just so variable. They're just someone that's there in the PBL process, I suppose.

Fear - always in the back of my mind

I think a lot of it [motivation] sadly, is the scare – fear. Always in the back of the mind, because it's a pass/fail now, that's just all everyone is really striving for, is the pass, got their pass, got to get

the pass, so seeing other people frantically working and you're thinking "Shit, I should be doing that too". I don't think it's competitive, but it's more if my neighbor is doing it I should be doing it too, plus more, more study as well. You're driven by the prospect of failing, that's for sure. Because that whole year you have to repeat and "Oh, god".

Without the patients I don't think you'd really remember why you're doing this

I find what's really refreshing is the weekly hospital visits and just getting out of the University situation and away from the textbooks and actually seeing patients in the real setting. If I see something I don't understand I'll actually go home and read up on it, even though it's completely irrelevant and I know it's not going to be in the exams, but just by pure actual interest. I think the actual clinical aspect, especially seeing hospital patients, is really motivating, perhaps just reminding you what you're doing this in the first place, because I think without that I don't think you'd really remember why you're doing this. Everyone has been so driven by the fear of failing and I think that's a really good break out of it and you think 'Yes, that's why I'm doing it because I want to be out there doing this one day and just have to get through the next few years to finally get to that position'. Personally for me I get really excited, because that's why I'm doing it to actually be with people and help people, so that really gets me going, just seeing patients in hospitals. That motivates you in a really good way, like want to learn and I don't just want to do my study so I've got things to say in PBL, but actually want to do it for understanding and things like that. That kind of thing in the back of your mind 'Got to keep up with everyone else', it works, because that's why we're all studying like crazy people.

Little things along the way would just make it so much easier

After having thought about it more since the last session with you, speaking personally, I don't have a great ability to self-assess, I think because of the structure, the way it is, the fact that we're not given learning objectives and it's not outlined what we need to do, really, but I think I've developed the mechanisms of trying to self-assess. Even seeing what other people are doing in other PBL groups and seeing how much study my friends are doing, I suppose they're always compensation in a way. I don't see exams as particularly useful because by then it's often too late. You don't want to get to the exams and suddenly like 'Oh, I wasn't doing enough'. Mid-year exams are good for that, but even now that they count, so it's too late really by mid-year exams to use that as your primary gauge of your progress. Little things along the way would just make it so much easier to know what sort of level you're driving towards, because we don't have tests and things like that. People didn't mind that, and more lectures, people would really like that. I think because we don't have those things in place and we need to do these other excessive measures like collecting the other group's PBL notes and photocopying them and doing their learning issues

and literally copying what other people are doing, the amount of work they're doing, and that's ridiculous that you have to do it.

The more you know the more you realise you don't know

I think now, this semester, even coming up towards the end of this semester it's gotten a lot easier for me personally. Perhaps I'm just getting used to it. The fact that now we've sat three lots of exams and I've almost come to terms with the fact that you can't know everything, whereas previously I think I approached Medicine like you would your High School exams, like you can know everything, you can study everything and get 100% and know it all, but with Medicine you can never know everything and the more you know the more you realise you don't know. Now I'm more conscious of not wasting time doing unnecessary things. I'm more conscious of just doing literally what is required or what I perceive to be required of it, Perhaps even since discussing it last time with you. It's really you do what you want to do, so just concentrated more on doing logical things. Do your physiology, do some anatomy and do your learning issues as opposed to just – I don't know - it's hard to explain. I just kind of approached it in perhaps a more systematic way.

I've been trying to talk more in PBL

I thought a lot about this thing about 'the amount you talk in PBL being reflective of how smart you are', literally. I think since then I've been talking more in PBL perhaps, just knowing that – I'd always done the work but just had problems getting it out there, and trying to talk – after talking a few times in the PBL session now it's just easy, but it takes those few times to then be recognised as being a more dominant member within the group and then anything you say is really appreciated, but until you kind of get to that status almost it's really hard. It's just a matter of once you've thrown a few things out onto the table then it's easier to keep doing it, but for someone that never really gets to that stage, it's just so hard. A lot of people seem to get really worked up and run down and a lot of people get stressed and depressed, and competitive. I think maybe that does stem from the fact that we're all gauging off each other, but I think that's the only way at the moment, unless we get a bit more standardisation of the course and be more aware of the learning objectives.

A year and a half of being in Med School to finally grasp the concept

PBL…It's really hard until you experience it yourself. I had no idea until I sat the first mid-year exam, but I'd tell them [new first year student] to check out what other PBL groups are doing just in case your own might not be quite as efficient as it should be. I'd tell them to study with their friends so they can gauge themselves on the level of their friends. Yes, I'd definitely say work. Don't just flog yourself away and work alone because you might be completely on the wrong track

and doing irrelevant things. Yes, I'd really recommend talking to other people and perhaps not be so specific. Go for understanding rather than ridiculous amounts of facts and figures and things like that, which I think is hard to know at the beginning what you need. I think maybe before starting the whole process I think students would really appreciate a bit more of an explanation of the whole PBL process and probably a more formal introduction to it and ways of gauging their progress and things like that, to save a lot of the hassle that I think people are going through now, because it's literally taken me up until these mid-year exams – that's a year and a half of being in Med School to finally grasp the concept and to turn it around and use it as a positive thing. That's been a year and a half of hating PBL and not really understanding why we need to go through all these formalities and the learning issues, data points, but now I have kind of tailored my learning in a way that it works positively with the PBL process. A year and a half to get to that point, that's too long.

Get your hands on past exam papers

That's the only way you can see what's been asked in the past and is what's expected of you. Actually, that's another disadvantage thing. Being in college [residential], often, because there are all the med students, so we get access to their past exam papers. Because we're friends with them they'll say 'You can borrow this, it's my exam papers for second year and you can have a look through them to see how you're going'. That's a really good gauge. They should have past year exam papers. That's if you've got access to it. If you don't have any friends – because we're not formally really given them, so you've got to get them by known dodgy means and if you don't have any friends in older years that are willing to do that for you, then I think that's a real limitation, because things like the multiple choice questions from the mid-year exam were word-for-word off the one last year's mid-year exam. It's not fair. That's not fair at all.

Appendix E

Cameron's First Narrative

I'm having to teach myself everything

I was lost to begin with because I wasn't exactly sure what they meant by self- directed learning. I still was under the impression that we don't need to be taught a lot of things but for me part of the trouble was finding what to actually cover when we were learning, like having to find the resources ourselves and go back and have a look and read over things and read it again and again. It was pretty tough. I feel like now I'm having to be the teacher and not just the student where I would be taught directly what I have to learn so I'm finding that I've got to take on a more mature role so I'm having to go back and teach myself everything as opposed to being taught by other people.

None of us had any idea

To begin with I had no system whatsoever because it was just a lot of trial and error but I've developed a system now where I know where to aim for and what to do but that process has taken quite some time to develop. The key thing is what's best for me because a lot of people are different. I tried my high school methods of learning where I was just trying to rote learn everything and read facts and then try and memorise things but I found that didn't work at all so I moved on to try and actually read things and try and develop some understanding about it before I actually tried to look into it because with the course being medical and all that sort of stuff it was - I had to know basics before I could start learning about procedural stuff so it was - I had to go back and try and develop understanding before I could actually tackle things.

At the start it was such a broad range of things to cover - like we had no idea. Being first years none of us had any idea really what to cover. I called upon my peers to try and get some help, some assistance and some direction. My PBL report cards and my exam results, [end of Year 1] weren't very good, but particularly my first semester exams I did rather poorly. I think I failed all three, but - - -Yes. It was quite a shock because I'm expected - like all through high school was just a breeze. I could hand up anything and get an A for it but for this it was really tough and then to realise that I have to really work hard.

Shock to my system

In first year I was still under the impression that it was all like tutor driven and everything and I was going by what my tutor had told me. I didn't have a very good experience with my first PBL tutor and I only found out how I was going at the last minute and I don't think I was very good so that sort of set me back as well. There is a section that's based on your knowledge and most tutors give you feedback during the course of the semester - whereas this one just saved all it up

for the report so it was just a bit of a rude shock when you thought…. Okay… I know nothing. I was a very good student at high school and you got by and then you come to the first semester and those weeks of the first semester if you weren't getting feedback from the tutor. I thought I was doing okay but… I just had an idea that I wasn't up to scratch because I wasn't grasping concepts. Because I hadn't done anything like this before so it was a bit of a shock to my system but it still would have been nice to actually hear that from someone else during the process, rather than myself, because as much as you tell yourself you always doubt - well maybe I am doing okay sort of thing. I know it is a student driven thing but just - especially in that first year because you're pretty vulnerable and you have no idea what to expect so at least for the first semester you get some sort of direction from those who are tutoring you and maybe then they can help to develop the self- directed sort of learning.

I had to try a completely different method of learning

I was pretty upset to begin with but I realised that I did have to try a completely different method of learning because it just wasn't working, and I found with the second semester of first year part of the difference was my PBL group. It was really good - our tutor was supportive and telling us constantly like you're heading in the right direction or something like that and it sort of made you realise that you were doing the work properly and you were - and it helped with understanding it.

I also found I just had to go back to basics because you've got to work around those learning issues, and don't just answer those questions specifically, like you've got to work around it, go back to basics, learn about normal before you can think of abnormal and, yes, just going back to that because that's what I wasn't doing in the first semester. It involves a lot of work but it's helpful and in the end I'm actually understanding things as opposed to trying to memorise facts.

Forced me to actually do more work

With this group, this semester also, it has sort of been that we don't put everything up on the board so a lot of it you've got to be able to find yourself so you have to do all the work yourself as well. It's just basically putting it all together for the case session which has changed for this semester but, yes, it has made, *forced me,* to actually do more work too to make sure I'm actually getting all the concepts myself, not just within the group. We still raise it just to go through it verbally but, yes, not actually putting things down as we were in first year especially.

It was just like learning a completely new language

Failing the first exam…that was the scary thing because I thought after finishing first semester, like without my exam results back, I sort of wanted a kick up the backside because I felt in myself I wasn't doing this properly and I felt like I didn't understand anything and just talking to other people *they* seemed to know everything. I was just lost. It was just like learning a completely new

language. I do feel more comfortable with it because I at least know where I'm heading and I've had good tutors so they've helped to support that - point me in the right direction.

Exams - I just hope; fingers crossed

Leading up to the exams all the tutor reports come back and a lot of it depends on your tutor and how well they assess you and like some people are pretty generous with it so you still don't really know but I don't know, you just - I still don't know how I'm going to go in the exams leading up to them. I just hope; fingers crossed. Last semester was great, like she [my tutor] really worked towards the exams and told us that we were doing really well and stuff like that and in that sense that was reassuring but, yes, still that unknown, because you still don't know - also you don't know what to expect in the exams, so you might not know every little bit of detail on this one thing so that, yes, it's a hard one to explain. I think a lot of it is developing methods also yourself to help you study. In that sense I've worked out something which works for me and in that sense it's good but otherwise you still don't get there. I try to review after each case but I don't do it like in detail. Most of that I just work up towards exams and then cram, yes. I make sure that all the learning objectives that we've covered, everything that's in the case, just to make sure we've got some sort of understanding on those, maybe not in detail I must say but at least know, yes, I've covered that.

I've come this far so I must be doing something right

When working out what's important I just think about it and also I suppose talking with other people outside of the group but yes, just have a think about it and was it really a big feature of the case and was it necessary for me to learn that, but otherwise I just - I'm not a very good student- I'm not going to go out and learn about it straight away if I haven't learnt about it during the case. Because...like the *other* students do all the learning - not me. I'm not like the others, no, yes, I don't know - I think I just do things differently. A lot of people there are really hard workers but I'll take it as it comes and for me if it didn't stand out. I know a couple of my friends - say it's like a case of xyz they'll panic and make sure they do copious amounts on it and things like that. I just sit back and go 'I didn't learn about that but I don't know if it's relevant' sort of thing so in that way I'm different from them. But, yes - - -sometimes it can stress you out too - their stress can influence you and I go 'Oh, gee, maybe I haven't' but then again I go no its OK., I guess I could say I have enough confidence in myself to know 'Okay, I don't really have to listen to what they're saying because I think it's unnecessary how much stress they're putting themselves under.' Yes, I look at the end of the day, particularly with exams and everything and go 'I've come this far so I must be doing something right.' I need to maybe stress a bit more but not so much as some of them where they're just panicking but I don't know. I'll say I'm just average. I find a lot of people are really panicking already about exams but for me I'm just like relaxed and I feel like I can just

switch off and when I go home it's just like take the weight off my shoulders and then it just gives me that time to reflect and think about what I've been doing over the day

I don't really want to be a quitter like my mum's always told me

I suppose one thing which does help me, to motivate me, is I can see where it's going so I can see the future, where it's going to lead and how it's going to help me in the long run so it makes me want to learn about it and do more. I think one of my problems in terms of lacking motivation is I feel I'm still pretty immature and I'm still young and everything and I'm not sure if this is exactly what I want to do. I had some idea like doing medicine is going to be hard and a long time and everything but if you haven't experienced it you underestimate. I'm probably just forcing myself to do well because my whole life at high school I always wanted to excel and everything and so I don't want to drop the standard. It doesn't quite sound right - really cheesy – but I've always liked to achieve something I've set out to. I don't really want to be a quitter like my mum's always told me. You never say die.

In high school I was always like trying to be top

Even when I was a kid - I went to not the best school and I set really low goals and I wanted to be a bank teller or something like that, nothing where you had to go to university or anything. Then I wanted to be a chef and then once I hit high school they realised I had some intelligence and once I was there they said 'No, do you want to do something that's sort of worthwhile in life? Something smart people do?' Then I thought about law and medicine and everything but medicine was always in the back of my head but I never thought I could get there. When I was younger you think: Oh, I'd love to do that. But never think at the time that you can get there but I suppose once I hit high school the realisation came that I can get there. I found in high school I was always like trying to be top and everything because there was that competition. I always set really high goals and then tried until I got there but I suppose here I'm just aiming for a pass because that's what gets you through in the end but I find a pass really is pretty much as high as what I would set in high school because of the comparison in terms of the work and everything - a pass is fantastic at the moment with all the med work. Some people can still set those really high goals to really excel but for me at the end of the day we're all the same. We're all on the same level field.

Appendix F

Cameron's second narrative

Just having a bit of a chat

To see how I'm going with cases, what I usually do is I would compare myself to a lot of my peers just through discussing, so within my PBL group I find just talking about the cases, like particularly at the end of the case we'll have a bit of a session where we're just discussing if we had any problems and just having a bit of a chat in a less formal manner, not going through learning issues or things though, just a chat and then we just put things up together and work out where we're going and by that I can sort of gauge how well I've covered the case and if there's any bits that I've missed, so incorporated in that is we just go through the case objective and I guess by just looking over that I find I'm able to gauge where I'm at to see how I'm going and aside from my group just talking to my friends. I find that really helpful because there's a lot of variation between groups and so other groups will cover things in more detail and it also depends on the tutor so just talking to them, just having a chat and finding out what they found was helpful in the case and what they thought important concepts were, just help me evaluate where I was going and see if I was doing the right thing and if I was doing it well - just to see if I was covering the right aspects of the case.

Lots of Variation

With my friends being in different groups there's a lot of variation between what the tutor and what the group itself considers- student directed learning. What they think the important concepts of the case are and how much detail they go into it. Because you get the case objectives or you work them out but still you don't know to what extent to cover them and you didn't know if you were doing the right thing. Have I gone into too much detail with this one or is it a minor point and I think just gauging what other people have done and seeing what they think is a good standard for that particular objective or the case just gives you some idea of have I done enough? Have I done the right thing sort of thing?

Sometimes you think oh no I've completely done the wrong thing and it puts you under a bit of pressure so in some ways it can work against you because people will go this is the main point- I've done this much on it so I'm like I haven't done that much so it's a bit worrying. I guess that's part of it because then you know what standard - but then again they might be wrong so a lot of it you've just got to work out okay you've got to think yourself - I put myself here as well just to think okay, is it really that important? So like just thinking myself, gathering what they have told me and what they think are the important concepts and just seeing do I think these are reasonable and things like that.

Session 1 –You can't predict a case

A lot of my friends and people in the group try to predict what's happening and then particularly with the last case I know that people read the year objective and they went 'Okay, the next case is on anorexia.' I don't know what happened but they may have picked up or something and then they changed it completely to obesity so people were just like - but see I try not to predict what's going to happen because otherwise it works against you and you've learnt irrelevant things. You've got to wait until it comes to you and I suppose that's how you approach a patient - you can't predict how a patient is going to present so you just wait. Because it's the start of a new case and usually it's something we haven't really heard of or it's pretty unknown - I know its student driven but our tutor helps quite a bit. He doesn't actually point it out to us but it's just helpful having him there and he'll - if you're going off on a tangent and it's not relevant he'll just go 'Okay' and maybe focus on this a bit more or not so much on this.

Everyone's talking about the new case

After the first session everyone is talking about the new case and you're just trying to find out what your friends and other people are doing. Just talking with them, finding out what they did, because it is tough after the first session when you see them. You're not quite sure, particularly after the first one you want a bit of guidance and knowing am I going to go home and do the right thing by learning the issues and things like that. During the session they will raise a lot of questions because the first session is just a lot of questioning like what is this or what is that and so I pick up on that and even though you will have certain learning issues and things like that you've got to sort of listen to what the group says because they're not quite sure about this. I'll just question it - it might not necessarily have it as a learning issue but you can still think about it, maybe not as a learning issue but at the back of your head, they raised that question for a reason. Should I check that out or is it relevant?

Assessing the relevance?

I don't know. I don't really; I just try to do everything that was listed and make sure I covered everything that we raised as questions and things like that. I don't really like- there's no comparing or anything. I just try to cover all that I can and knowing myself I think I've done it all and I have an understanding of what to do next. After session 1 and you've done those learning issues in the private study it's sort of predicting what's going to happen next, I guess, because you have at least some background knowledge so if this happens you know what to do, so I just look at what I've researched and try and work out where to go to from here and take from the patient and do that sort of thing.

Sessions 2 & 3 - Pulling all the information we've got

In this session I think it's the degree of information that's important. It's all pulling all the information we've got, pulling it all together because you won't find everything and someone else will have this other little fact and something like that. Once you get it all together it increases the understanding of the case and things like that, so the group is really helpful and assesses did I do the right thing and have I covered it in enough detail, because sometimes - you have a lot of learning issues after the first session and you realise you can't do all of them and also some of the people are going to cover to varying extents. You find that once you get back to session 2 there's that problem and also by pulling it all together you end up with a better understanding. I guess after session 2 you have more of an understanding so you progress yourself. I tend not to - like friends are important at the end where you discuss everything but at this stage probably just the group and just myself, just knowing, okay, so I've got some direction now. Where do I go? So, yes. I study it and just do what we've discussed in session 2, what new points have been raised and any questions we want to answer. I find sessions 2 and 3 are very much the same because it's just building and building and the main things are the introduction and conclusion of the case any changes and everything.

Session 4 - We are just wrapping everything up

Session 4 is largely like the group where we are just wrapping everything up, pulling everything from the case together to try and reach - not necessarily like they don't diagnose and don't lead to full conclusions - but just so you know everything that we've covered in the case and how it ties in with everything because you can just have a lot of loose facts everywhere and what did I use that for? But with the last session the group gets together and goes 'Okay, so this is how that related to this problem' and things like that. I suppose in terms of case objectives that's where that comes into it, where we cover it.

Working out what's important in the case

I think about it again because I notice when we're doing case objectives a lot of people just put up everything there is to know, cover everything, and not all of its important so I just work out okay, if I did miss bits were they really important? I just think about it and also I suppose talking with other people outside of the group to see if they had it as an objective and to see if it was relevant but, yes, just have a think about it and was it really a big feature of the case and was it necessary for me to learn that, but otherwise I just - I'm not a very good student- I'm not going to go out and learn about it straight away if I haven't learnt about it during the case.

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