Using Assessments of Contextual Learning to Identify Characteristics of Adaptive Transfer in Medical Students

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Abstract

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Transfer of learning from curricular experiences to non-academic settings is a primary goal of any academic institution. In cases where skills, knowledge, and attitudes learned in curricular experiences are used to solve complex and varying problems, transfer is especially difficult to define and measure. Two promising areas for defining and measuring transfer are a) competency-based education, which defines outcomes in terms of how skills, knowledge, and attitudes should be used in context, and b) adaptive transfer, which views transfer through the lens of developing adaptive expertise. This study attempts to better define transfer in medical education by comparing competency-based evaluations of two required components of a large MD program: problem-based learning completed by MD students in their second year, and a family medicine clerkship completed by the same MD students in a subsequent year. Using factor and correlational analysis, the study corroborated earlier studies that show the importance of knowledge for expertise. The study found evidence to support the existence of adaptive transfer as a phenomenon that includes selectivity and problem-finding. Areas for further research include validation of competencies that emphasize flexible use of knowledge, and study of the problem-finding process in interdisciplinary teams.

Keywords: Competency, competency-based medical education, behavioral anchor, adaptive expertise, adaptive transfer, selectivity, problem-finding, problem-based learning, medical education

Dedication

To my parents Ted and Marlyn, my wife Lynn, my daughter Amelia, and to the medical students at the University of Washington and the people they will serve.

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John Bransford has challenged me and encouraged me; often saying “this is a great start” and then showing me that more is possible. When seeing him teach, I admired and learned from his ability to listen, observe, and appreciate people of all sorts, including me.

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Contents

Introduction

Medical schools around the world recognize that their curricula must be renewed on a regular basis to keep pace with developments in human learning and patient care (e.g., Allen & Ryan, 2011). Among the areas identified for continuous improvement are:

- Increasing assessment validity by using authentic, contextual assessments (Epstein & Hundert, 2002; Howley, 2009);
- Increasing transfer from formal learning to competency in clinical settings (Eraut, 2004).

The two are closely related, in that contextualized assessments are needed to observe transfer of learning. They are also related to a movement in medical education to focus on behavior-based competencies that can be used to define and assess clinical practice.

Contextualized Assessments, Competency, and Behavioral Anchors

Contextualized assessments and competency-based assessments use *behavioral anchors*, or observable behaviors that indicate competence in a particular area.

A key assumption behind competency-based assessment in medical education is that cognitive processes such as clinical decision making and patient-centered care all have valid behavioral anchors. The validity of these anchors depends on observation of the student in context, and over a long enough period of time to see how the student reacts and adapts in different situations.

Anchors are developed and validated by committees of experts, usually based on their own clinical and teaching experiences.

As with any assessment system based on specific and measurable behaviors, competency-based medical education based on behavioral anchors runs the risk of being reductionist to the point that the overall goals are missed. To reduce this risk, anchors are re-evaluated periodically, and they are also accompanied by space where a rater (a preceptor or tutor) can explain their rating and add observations that might be otherwise missed.

Purpose and Description of the Present Study

The purpose of the present study is to better understand the relationship between common behavioral anchors for competence, and an important goal of medical education – transfer of what has been learned in the MD program into real-world practice.

More specifically, this study will investigate how behavioral anchors in assessments of contextual learning might be used to identify characteristics of *adaptive transfer*.

Adaptive Expertise and Adaptive Transfer

Adaptive expertise is "…procedural fluency that is complemented by an explicit conceptual understanding and sense of personal identity that permits adaptation to variability," while avoiding the over-application of previously efficient schematized actions that worked in the past but need modification when new issues arise ((Hatano & Oura, 2003) as quoted in Lin et al., 2007, p. 3).

Adaptive transfer is a special case of adaptive expertise, in which a student is using what has been recently learned in an adaptive way, such that the student is not using a rigid routine but is modifying learned approaches to suit both the situation and the patient.

Adaptive transfer is part of the essence of professional activities manifested by complex, integrated capabilities that can be lost if behavioral anchors become overly-reductionist.

Data Used in the Present Study

The study will use data from two cohorts of medical students:

- Students who took a one-quarter PBL[1] seminar in 2010;
- Students who took a one-quarter PBL seminar in 2011.

The sources of data are two contextual qualitative measures of competence:

- Problem-Based Learning Evaluations, completed by PBL Tutors[2];
- Family Medicine Clerkship Evaluations, completed by Clerkship Preceptors[3]

To provide additional insights and to look for confounding factors, the following data will also be used:

- MCAT scores (Verbal Reasoning, Physics, Biology);
- Birthdate and gender;
- Responses to a PBL Survey, filled out by students;
- Responses to a PBL Follow-up Survey, filled out by residents.

The Chapter entitled **Measures and Variables Used** will describe the settings from which data were gathered, along with the content of each item.

[1] See Appendix C for information on the PBL curriculum during 2010 and 2011
[2] PBL seminars consisted of about 10 students led by a facilitator who is called a Tutor. Some, but not all, tutors had clinical experience
[3] A clinical preceptor is a practicing physician who mentors a student onsite

Table 1

Measures Used, Years when Measures Were Taken

Year in education	Assessment Name	Comments
0	MCAT	Standardized, multiple choice admission test
1		
2	a) PBL Evaluation b) PBL Survey	a) Qualitative evaluation of student performance, by tutors b) Student survey, rating the quality of their PBL experience & effectiveness of their tutors
3	Family Medicine Clerkship Evaluation	Qualitative evaluation of student performance, by preceptors *Often done in year 3, but sometimes in year 4*
4		
5	PBL Follow-up Survey	Survey, rating the effectiveness of their PBL experience. Usually filled out during residency for 2011 PBL cohort, and afterward for 2010 PBL cohort
6		

Chapter 1: Background and Literature Review

Problem-Based Learning (PBL)

Problem-Based Learning (PBL) is an instructional approach in which students in collaborative groups learn through focused, facilitated problem solving and self-directed learning.

Various forms of PBL have been developed for medical education (Barrows, 1986). This paper will focus on PBL as developed and refined by Barrows and his colleagues, which has key characteristics summarized here from (Savery, 2006) and Barrows (2002):

- Problems are ill-structured, meaning they are presented as unresolved so that students will generate not only multiple thoughts about the cause of the problem, but multiple thoughts on how to solve it (Barrows, 2002);
- Problems are important, realistic, and relevant to the fields students are studying;
- Students work in collaborative groups that support distributed cognition;
- Students take responsibility for their own learning, and they apply their learning back to the problem they are working;
- Learning integrates a wide range of disciplines or subjects;
- Students analyze and abstract what they have learned so that it can be applied to new problems;
- Students continuously monitor and evaluate their own thinking and problem solving process, as well as the thinking and processes of the rest of their team.

PBL was developed in the 1960s for medical education by the late Dr. Howard Barrows, who was then at McMaster University School of Medicine (Barrows, 1980; (Albanese & Mitchell, 1993). The original purpose for PBL was to improve transfer classroom learning into clinical settings (J. D. Bransford & Schwartz, 2009). The desired transfer can be summed up with Barrows' conception of the purpose of a medical degree: *The physician should be able to evaluate and manage patients with medical problems effectively, efficiently, and humanely* (Barrows, 1980, p. 3).

In the decades since PBL was first developed, it has been extended to middle school and high school education, and also to postsecondary and graduate education outside of medicine. This paper will focus on PBL in medical schools, for the education of future MDs.

The development of PBL represents advancement in the understanding of how people learn. However, of equal significance (though sometimes overlooked) is how it reflects evolving values for medical education: at its best, medical education is motivating, humane, enjoyable and challenging for students and faculty, supports lifelong learning, and instills a positive attitude toward learning from peers and from patients (Albanese, 2000; Bligh, 2000; Norman & Schmidt, 2000).

The PBL Tutorial Process

A problem is worked in a cycle known as the PBL tutorial process.

In the process, students co-construct knowledge with the help of a whiteboard or digital document where they record the known *facts* of the case, *ideas* for evolving hypotheses about the case*, learning issues* or questions that need to be resolved, and *action plans* or steps needed to resolve the problem. This document helps to make students' thinking visible for the entire group, scaffolds the reasoning process, and acts as a shared platform for negotiation.

The steps in the tutorial process have been parsed and labeled slightly differently by different authors, but all describe essentially the same process. The following list of steps is generalized from descriptions in (Barrows, 1980), (Barrows, 1986), (Barrows, 2000), (Hmelo-Silver, 2004), (Albanese & Mitchell, 1993), and (Savery, 2006):

1. **Initial encounter**: a case is presented to a group of students. The presentation can take many forms, including a description on paper, a video vignette, or a person trained to be a standardized patient.
2. **Find and analyze the problem, develop multiple hypotheses**: the students find and represent the problem (i.e., determine the patient's true complaint, the type and severity of the problem, and immediate priorities) by identifying relevant facts from the scenario. They develop multiple hypotheses for the diagnosis(es) and the best therapeutic decisions. This step includes distinguishing known facts from ideas or hunches that would require more information to verify.
3. **Identify and take ownership of individualized learning objectives**: each students identifies what he or she needs to learn (learning objectives) in order to help refine, rank, verify, or eliminate the group's hypotheses.

4. **Self-directed learning (SDL)**: to meet their learning objectives, students find and use resources such as libraries and experts.
5. **Share and apply new learning**: students re-convene, share what they have learned, and apply their learning to refine, rank, verify, or eliminate existing hypotheses, or to create new hypotheses.
6. **Closure of the case**: the group arrives at a diagnosis and a recommendation for treatment. The recommendation may be in the form of what they would say to the patient and how they would say it. The facilitator then shares what the case authors consider to be the correct diagnosis and recommendation for treatment.
7. **Reflection and abstraction**: students reflect on the problem and what they have learned, so that they can apply their learning to new problems, new self-directed learning, and new collaborative work (Gijbels, Dochy, Van den Bossche, & Segers, 2005).

What PBL is *Not*

PBL is related to, but not the same as, other methods of contextual and experience-based learning including *challenge-based learning*, *project-based learning*, *situated learning*, and *anchored instruction*. The most important differences between the methods tend to lie in the degree to which the problems/challenges/projects are ill-defined, the method by which the facilitator provides direct discussion, the degree to which students must take control of their own learning away from the classroom, the approach to metacognition, and the way in which the students and facilitators bring closure to a given problem, project, or challenge.

Discussions on the differences between PBL and other contextual and experience-based learning methods can be found in Savery (2006) and Hmelo (1998).

The Role of the Student and Facilitator

The following goals for PBL students and facilitators, taken from Hmelo-Silver & Barrows (2006), are representative of how the roles are described in PBL literature.

Educational goals for students:

> E1. Explain disease processes responsible for a patient's symptom and signs and what interventions can be undertaken.
>
> E2. To employ an effective reasoning process.

E3. To be aware of their knowledge limitations.

E4. To meet their knowledge needs through self-directed learning and social knowledge construction.

E5. Evaluate their learning and performance.

Performance goals for facilitator:

P1. To keep all the students active in the learning process.

P2. To keep the learning process on track.

P3. To make the students' thoughts and their depth of understanding apparent.

P4. To encourage students to become self-reliant for direction and information.

PBL is a student-centered method, employing student-centered discourse, meaning that students drive the discussion and the facilitator serves to scaffold the learning process (Collins, Brown, & Newman, 1989). Students determine what they need to learn. It is up to the learners to derive the key issues of the problems they face, define their knowledge gaps, and pursue and acquire the missing knowledge (Barrows, 2002).

The teacher "acts as a facilitator to guide student learning through the learning cycle" (Hmelo-Silver, 2004, p. 236), and to scaffold students' metacognitive skills. Teachers (facilitators, often called tutors) in PBL are experts in scaffolding and modeling the metacognitive, collaborative, and SDL stills required to solve the problems in PBL and to abstract the learning for use in new situations.

SDL and Closed Loop PBL

In PBL, the term *closed loop* refers to students taking the outcomes of their self-directed learning (SDL) efforts back to the group, to share and discuss what they have learned and to re-assess the problem.

Walker & Leary (2009) conducted a meta-analysis of PBL outcomes across domains and found that a closed-loop implementation (in which students bring the results of their SDL back to the problem, to "close the loop") supports the best outcomes. Closed loop tutorial processes require problems with sufficient complexity to allow multiple hypotheses and multiple learning objectives.

Not everyone who uses the term *PBL* is referring to a closed loop implementation. According to (Barrows, 1986) a closed loop implementation of PBL supports the best outcomes for structuring of clinical knowledge, developing clinical reasoning skills, motivating students and fostering self-directed learning skills. This is because the discussions that occur in Step 6 and Step 7 (as described earlier) supports more explicit understanding of correct and faulty understanding and reasoning.

The present study uses data from a closed loop implementation of PBL.

Learning across Disciplines and Collaborative Learning

Problems used in PBL require students to synthesize and apply knowledge from different disciplines that are often taught separately. Students are able to elaborate on the connections between the disciplines, with the goal of structuring and contextualizing their knowledge for recall and use in clinical settings (Barrows, 1980, 1986, 1991; Bransford & Schwartz, 2001).

Most PBL groups at the UW School of Medicine brought together MD and Physician Assistant (PA) students, for the purpose of supporting cross-discipline (interprofessional) teamwork and communication. For many students, this was the only course in which they worked side by side with students outside of the MD program, and it provided an important experience in working in an interdisciplinary healthcare team. However, some of the groups had only MD students.

At every stage, each student shares his or her expertise with the group, so that the expertise can be synthesized (with the help of a whiteboard or shared document) to find the problem and identify learning goals. The self-directed learning (SDL) component models how professionals divide and share learning tasks in clinics and other settings. The entire process models how all healthcare professionals must learn to understand the value of the experiences and expertise of people within their profession and in other professions. The patient is also a source of expertise (as the patient is an expert on his or her situation and health history), though unless the course is using an actor trained to be a standardized patient, the patient is not able to actively engage in conversation or problem solving.

Acceptance of PBL and Debates about Its Use

PBL is widely used in preclinical medical education in the United States. A 2003 survey (Kinkade, 2005) of the 123 Liaison Committee on Medical Education-accredited medical schools in the United States found that 70% of the schools used PBL in the preclinical years[4]. Using PBL as one relatively small component in an overall curriculum was common: 45% used it for less than 10% of their formal teaching; 6% for more than half of their formal teaching.

A 2009 editorial in the Interdisciplinary Journal of Problem Based Medicine titled *Summarizing Findings and Looking Ahead to a New Generation of PBL Research* concludes that recent research points to "…promising results in medical education and to a new generation of PBL studies taking place outside the field of medicine" (Ravitz, 2009, p. 9).

Underlying Psychological Mechanisms of PBL

The underlying psychological mechanisms in PBL have been described from the standpoint of many perspectives including information processing, metacognition, cooperative learning, constructivism, expertise, preparation for learning, self-directed learning, adult learning, and situated learning (Albanese & Mitchell, 1993; Bransford & Schwartz, 2001; Colliver, 2000; De Grave, Boshuizen, & Schmidt, 1996; Hmelo-Silver, 2004; Norman & Schmidt, 1992; Onyon, 2012).

Psychological mechanisms can also be understood in terms of the goals that Howard Barrows set for PBL, as summarized in (Hmelo-Silver, 2004):

1. Construct an extensive and flexible knowledge base;
2. Develop effective problem-solving skills;
3. Develop self-directed, lifelong learning skills;
4. Become effective collaborators; and
5. Become intrinsically motivated to learn.

[4] This survey did not distinguish between different definitions of PBL. While the literature supports a specific set of key characteristics of what constitutes PBL, not everyone includes all of these characteristics in their implementation of PBL.

Studies of the Effectiveness of PBL

The effectiveness of PBL for medical education has a rich evidence base spanning four decades. PBL research can be classified as either comparison studies (PBL versus non-PBL or "traditional") or case studies of individual programs or courses. Quantitative studies in either category often use board exams (such as the National Board of Medical Examiners I and II exams) or scored qualitative evaluations of student performance in clerkships or residencies. Qualitative studies often examine the structure and coherence of students' arguments, or student attitudes about PBL and the types of problems used.

Comparison Studies of PBL vs. Lecture

Not all comparison studies use the same distinction between a "PBL" condition and a "non-PBL" or "traditional" condition. In general, the PBL condition uses “closed loop” PBL, and the non-PBL condition is a combination of lecture and lab courses normally taught in medical schools in the US and Canada for basic health sciences.

In practice, elements of the two conditions will overlap. For example, "traditional" learning often contains students discussing problems in groups, either as part of class activities, or informally outside of class. PBL students may seek out recorded or live lectures in their self-directed learning (SDL).

PBL and Physician Competency after Graduation

Koh, Khoo, Wong, & Koh (2008) analyzed effects on physician competency after completing an MD program in a meta-analysis of studies that compared evaluations of students graduating from PBL and non-PBL. Out of 102 article candidates in the evidence base, they included thirteen which met criteria such as the use of a control group and the use of quantitative data analysis.

They categorized PBL effects according to 27 competencies, grouped into Technical, Cognitive, Social, Research, Teaching, Managerial, and Knowledge domains.

This study found strong positive effects in observed (as opposed to self-assessed) competencies:

Technical:
Diagnostic skills or accuracy

Social:
Communication skills
Appreciation of cultural aspects of health care
Appreciation of legal and ethical aspects of health care

Cognitive:
Responsibility, reliability
Coping with uncertainty

Managerial:
Self- or peer appraisal

Self-assessments also showed a strong positive effect for PBL in Coping with uncertainty and Appreciation of legal and ethical aspects of health care. Self-assessment different from observed assessment in showing a strong PBL effect for these competencies:

Technical:
Continuity of care

Social:
Teamwork skills
Appreciation of social and emotional aspects of health care
Appropriate attitudes towards personal health and well-being

Cognitive:
Use of computers, information resources
Understanding evidence-based medicine
Knowledge:
Possession of medical knowledge

Case Closed on PBL Effectiveness?

Decades of research has shown a pattern that PBL students tend to score slightly lower on assessments stressing the recognition of facts in multiple-choice tests (e.g., multiple-choice questions in the NMBE I), higher on assessments stressing free recall and clinical reasoning where students can show their thinking (e.g., NMBE II), and higher in evaluations of situated clinical performance (Strobel & van Barneveld, 2009).

Strobel & van Barneveld (2009) considered the question settled on the overall effectiveness of PBL, and wrote that:

> Findings indicated that PBL was superior when it comes to long-term retention, skill development and satisfaction of students and teachers, while traditional approaches were more effective for short-term retention as measured by board exams (p.1).

Meta-analyses examined by Strobel & van Barneveld include many of the studies examined for the present literature review: (Albanese & Mitchell, 1993), (Beers, 2005), (Venon & Blake, 1993), (Dochy, Segers, Van den Bossche, & Gijbels, 2003), (Kalain, Mullan, & Kasim, 1999), (Newman, 2003), and (Gijbels et al., 2005).

(Albanese, 2000), acknowledging that some people in the medical education community continue to question the efficacy of PBL asked, "What if PBL has no effect on knowledge acquisition and clinical skills?" He points to the effects of PBL on students and the medical profession; that enhancing the work environment for students and faculty is a worthy goal in itself. Studies have also shown that PBL graduates are more likely to be accepted into their first choice of a residency placement (Albanese & Mitchell, 1993), get higher ratings in clinical clerkships (Richards et al., 1996), reason with more coherence about clinical problems (Hmelo, 1998), and are more likely to stay current with developments in medicine (Shin, Haynes, & Johnston, 1993).

Negative Effects on the NMBE I Exam

Comparison studies consistently show that PBL students tend to perform at a slightly lower level on the NMBE I exam. While the NMBE I's multiple-choice format is not a high fidelity representation of how students encounter and solve problems in clinics (a source of disagreements about its validity), it is a

measure of knowledge. Since knowledge is essential for expertise, lower scores on the NMBE I exam should not be ignored.

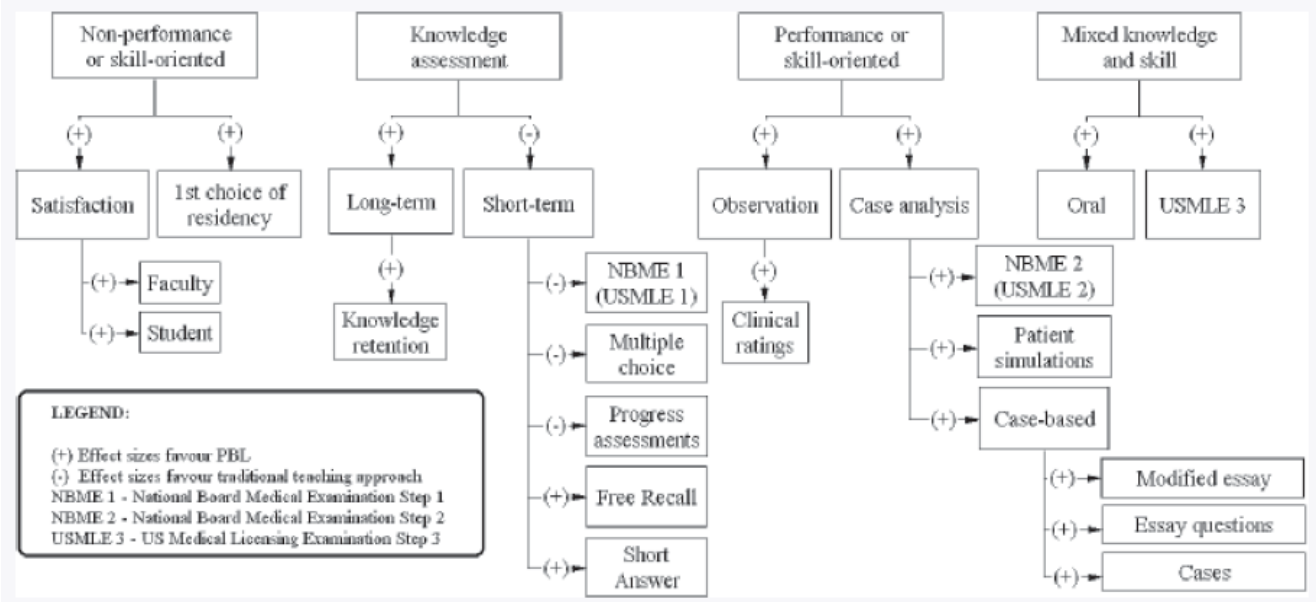
(Albanese & Mitchell, 1993) examined the questions "do PBL students develop the adequate cognitive scaffolding necessary to easily assimilate new basic sciences information," and "to what extent are PBL students exposed to an adequate range of content." On the first question, they concluded that lower scores on tests of basic sciences were troubling, and that clinical evaluations (which tend to be more favorable for PBL students) do not provide enough information on exactly where PBL students may have more gaps in their knowledge. On the second question, they concluded that based on lower NMBE I test scores, students might not be exposed to an adequate range of content, but again, there is not enough evidence on exactly where the gaps may be. They cite a study by Dolmans et al (1982) in which student-generated learning objectives (for SDL) were compared to faculty objectives, and found that 62% of the faculty's objectives were contained in the set of student objectives. Assuming that faculty objectives are more valid than student objectives, this suggests a need for curricula to provide guidance to students on where to focus.

The evidence base shows that students learn in both PBL and in non-PBL settings, and that PBL and non-PBL formats have different advantages (e.g., non-PBL may facilitate broader coverage of basic science). Many institutions such as the University of Washington School of Medicine use a combination of non-PBL class formats to build knowledge in domains such as anatomy and physiology, and PBL to synthesize, contextualize, and elaborate that knowledge.

Learning theory and learning science shows that any curriculum must have opportunities for novices to be exposed to the thinking of experts (J. D. Bransford & Schwartz, 2009), and that students need to be prepared to learn from experts (J. D. Bransford & Schwartz, 1998). These criteria can be met in PBL and in non-PBL formats.

PBL Effects and Assessment Types

Examining the phenomenon that PBL has shown different effects on different types of assessments, Strobel & van Barneveld (2009) analyzed the effects of PBL as measured by different types of assessments in different studies. They summarized their findings in the chart reproduced below (p. 52):



Note that the negative effects are clustered in the *Short-term knowledge* subcategory within *Knowledge assessment*. Within this subcategory are the NMBE I exam, multiple choice-exams, and progress assessments [of the learning of basic sciences relating to medicine]. Within the *Short-term knowledge* subcategory, free recall and short answer questions show a positive effect for PBL.

All other types of assessments show positive effects for PBL. Within the *Non-performance or skill-oriented* category, *1st choice of residency* is a reflection of students' self-evaluation of their interests and competencies matching the assessments of faculty and preceptors. The Performance or skill-oriented category shows that PBL has a positive effect on observations of clinical ratings as well as case analysis assessments.

This suggests that PBL enhances the transfer of clinical reasoning knowledge and skills to new problems and to clinical settings. Different measures (NBME 2, patient simulations, etc.) show different facets of the knowledge and skills being transferred.

Why Not a Larger Effect Size for PBL?

(Colliver, 2000) and (Albanese, 2000) wrote that learning theory predicts that PBL students should perform better on assessments of clinical reasoning. The effect sizes for PBL shown in comparison tend to cluster between .3 and .4, with MNBE II score effect sizes being smaller, and clerkship score effect sizes being larger. Both considered why the effect size is not larger, asking "what's the problem?"

Colliver argued that the problem is weak theory, and compared the effect sizes of .3 and .4 to a proposal in an early writing by Benjamin Bloom, that the maximum potential effect size for an educational intervention is two standard deviations when comparing an ineffective classroom lecture to an ideal one on one tutoring environment. Colliver considered one standard deviation as a reasonable effect size for a strong theory.

Albenese argued that there is no problem, and noted that in many domains including research to evaluate the effectiveness of medical treatments, and effect size of .3 would often be considered meaningful.

One explanation of the limited effect size is a ceiling effect among highly motivated medical students. Any group of students accepted into an accredited medial education program will likely produce assessment score distributions that cluster near the highest possible scores. This will allow less room (in terms of standard deviations) for improvement, so effect sizes will appear smaller.

Another explanation is that the comparison studies were not performed in laboratory conditions, nor would laboratory conditions have been the best approach. Human learning involves countless factors on biological, cognitive, emotional, and social levels. It is unreasonable to expect that learning outcomes can be changed dramatically by changing only one variable.

Competency Assessment in Medical Clerkships

Clerkships (medical students placed in clinical settings so they can practice medicine in a supervised, educational environment) have long been used in traditional medical schools to provide contextual learning opportunities. As will be shown in the forthcoming chapter on Measures, Variables, and Behavioral Anchors Used, the University of Washington's Family Medicine Clerkship's assessment uses categories and behavioral anchors similar to those used for PBL on the same students.

Family Medicine Clerkships at the University of Washington are mastery-based, in that students must achieve an expected level of competency before passing the course. Curriculum is highly structured and includes an online assignment tracker with weekly requirements that ensure that students have contact with a wide variety of patient problems. The program also includes webinars and interactive online modules featuring common family medicine, internal medicine, and pediatric cases. Competency is assessed in an online final exam (based on the online cases) and a qualitative assessment using behavioral anchors.

Lee and Wimmers, Construct Validity of Three Assessments

(Lee & Wimmers, 2011) examined clinical competence through the construct validity of three assessments:

- Preceptor's evaluations, using the Medical Student Summative Evaluation (MSSE) used by UCLA Medical School;
- Objective structured clinical examinations (OSCEs);
- National Board of Medical Examiners (NBME) subject examination.

Their goal was to better understand their conceptual structures and utility in the explanation of clinical competence. The first measure, the MSSE, is a contextual competency evaluation using behavioral anchors. A factor analysis found that the MSSE addressed different aspects of competence from the OSCEs and NBME, both of which are less contextualized. The authors concluded that all three assessments are necessary.

More detail on the MSSE is provided in the chapter on Discussion of Results.

Richards et al., 1996, Comparison of PBL and Lecture-Based Learning

(Richards et al., 1996), compared clerkship performance of students who took PBL to those who were in lecture-based learning at the Gray School of Medicine at Wake Forest University. Behavioral anchors for evaluation of clerkship students were organized into four scales, with five levels in each scale:

1. Amount of factual knowledge
2. Take history and perform physical
3. Derive differential diagnosis
4. Organize and express information

Their study found a difference between ratings using contextual behavioral anchors (the four scales listed above) and scores on a National Board of Medical Examiners (NMBE) subject test. students who took PBL scored hire on the contextual rating, but the same on the NBME as students in the non-PBL condition.

One important implication of this study is that decontextualized tests of knowledge assess different aspects of competency from contextualized assessments. Both types of assessment may be needed to give a more complete picture of student competency.

Competencies as Transfer

Transfer is broadly defined as the ability to extend what has been learned in one context to new contexts (Bransford et al., 2000, p. 51, citing Byrnes, 1996, p. 74). It is a primary goal of any educational system or institution.

Any medical competency can be viewed as a benchmark for transfer, in that it describes observable evidence that a practitioner is appropriately applying what they have learned. Behavioral anchors for transfer become more difficult to define for cases of adaptive transfer, where learners approach new and sometimes unpredictable situations.

Quoting (D. Schwartz, Chase, & Bransford, 2012):

> The overarching question for transfer should ask how people can strike a balance between (a) the efficiencies of seeing the “old in the new” and reusing what they know and (b) the adaptive

> learning that comes from seeing the “new in the old” and exploring learning opportunities that may exist. (p. 205)

In medicine, as in any profession that involves solving complex problems, transfer is a balancing act of applying existing knowledge from past problems while also gaining new knowledge for new, unique problems. In a student who is practicing and developing newly-learned skills and knowledge, this balance is *adaptive transfer* (D. L. Schwartz, Chase, & Bransford, 2012), which supports the development of *adaptive expertise* or "…procedural fluency that is complemented by an explicit conceptual understanding and sense of personal identity that permits adaptation to variability," while avoiding the over-application of previously efficient schematized actions that worked in the past but need modification when new issues arise (Hatano & Oura, 2003) as quoted in Lin et al., 2007, p. 3).

Many descriptions of physician competence imply elements of adaptive expertise and adaptive transfer. For instance, (Epstein & Hundert, 2002), in their survey of methods used to measure competency in physicians, found common themes which imply elements of adaptive transfer and adaptive expertise:

- Applying knowledge to real-world situations;
- Using tacit knowledge and personal experience;
- Recognizing gaps in knowledge;
- Self-directed acquisition of new knowledge;
- Recognition and response to cognitive and emotional biases.

Another example can be found in (T. Allen et al., 2011). His team surveyed family physicians for the Board of Examiners of the College of Family Physicians of Canada in an effort to better define competence in family medicine. His team found a dimension they termed *selectivity*. The dimension is discussed in a 2010 report:

> “This dimension has not, to our knowledge, been previously described with respect to physician competence, although it is surely not an original idea. It is the term that was chosen by the initial focus group to describe a set of skills that was frequently cited in the survey as characterizing the competent family physician: such a physician does not do things in a routine or stereotypical fashion but is very adaptable and selective in approach, modifying it to suit both the situation and the patient. Some of the ways in which a physician demonstrates competence in this dimension are as follows:

- Sets priorities and focuses on the most important
- Knows when to say something and when not to
- Gathers the most useful information without losing time on less contributory data
- Does something extra when it will likely be helpful
- Distinguishes the emergent from the elective and intervenes in a timely fashion
- Acts when necessary, even though information may be incomplete
- Determines the likelihoods, pertinence, and priorities in his or her differential diagnoses
- Distinguishes the sick from the not sick
- Selects and modifies a treatment to fit the particular needs of a patient and a situation"

(College of Family Physicians of CA, 2010)

Research Gap and Present Study

Adaptive transfer is difficult to define in situations where practitioners must define and solve ill-structured problems. To date, behavioral anchors for adaptive transfer and related concepts have not been fully developed or validated, although the need for such anchors is widely recognized.

This study will investigate how behavioral anchors in assessments of contextual learning might be used to identify characteristics of adaptive transfer.

Factor analysis and correlation analysis will be used to look for factors and relationships that resemble elements of adaptive transfer or adaptive expertise. Factors and correlations will be checked for consistency with evidence-based theory. If theory supports the factors and correlations, then the findings will be assumed to be evidence of one or more components of adaptive transfer that might be assessable, at least indirectly, with behavioral anchors.

Chapter 2: Measures, Variables, and Behavioral Anchors Used

This study involves data from two cohorts of medical students:

- Students who took PBL in 2010;
- Students who took PBL in 2011.

For each cohort, data are used from four measures.

This chapter will describe each of the measures, and where possible, will show the content of the items used.

Table 2

Measures Used, Years When Measures are Taken

Year	Assessment	Comments
0	MCAT	Standardized, multiple-choice admission test
1		
2	PBL Evaluation PBL Survey	Qualitative evaluation of student performance, by tutors Student survey, rating the quality of their PBL experience & effectiveness of their tutors
3	Family Medicine Clerkship Evaluation	Qualitative evaluation of student performance, by preceptors Often done in year 3, but sometimes in year 4
4		
5	PBL Follow-up Survey	Survey, rating the effectiveness of their PBL experience. Usually filled out during residency for 2011 PBL cohort, and afterward for 2010 PBL cohort
6		

Medical College Admission Test® (MCAT®)

The University of Washington School of Medicine requires Medical College Admission Test® (MCAT®) scores from all applicants. This test is administered by the Association of American Medical Colleges (AAMC). It has been in use for more than 80 years.

According to the AAMC website (AAMC, undated):

> The Medical College Admission Test® (MCAT®) is a standardized, multiple-choice examination designed to assess the examinee's problem solving, critical thinking, and knowledge of science concepts and principles prerequisite to the study of medicine. Scores are reported in Physical Sciences, Verbal Reasoning, and Biological Sciences.
>
> Almost all U.S. medical schools and many Canadian schools require applicants to submit MCAT exam scores.

The MCAT has three sections, each with a maximum score of 15 points. The sections are Verbal Reasoning, Physical Sciences, and Biological Sciences. The entire test is administered at test-taking sites, where students sit at computers that are partitioned from each other. More information is available in the Appendix titled *Student Account of Taking the MCAT Exam*.

Table 3

MCAT Sections, Topics, and Skills

Section	Content Topics Included	Skills Included
Verbal	• Humanities • Social sciences • Natural sciences	• Comprehension of stated and unstated ideas • Evaluation of arguments, conclusions, etc. • Application to predict a result or solve a problem • Incorporation of new information to re-evaluate ideas
Physical Sciences	• Chemistry, including bonds, reactions, and thermodynamics • Physics, including Newtonian mechanics, optics, waves, fluid dynamics, and nuclear physics	• Identification of main ideas (in passages) • Identification of components in a situation, and relationships among them • Seeking clarification • Hypothesis testing • Flexibility and adaptability in scientific reasoning

Section	Content Topics Included	Skills Included
Biological Sciences	• Molecular biology • Microbiology • Specialized cells and tissues • Systems of the human body • Evolution • Organic chemistry	• Evaluation processes • Reasoning using quantitative data

Problem-Based Learning Evaluations of Student Performance

Tutors in the UW School of Medicine's multidisciplinary PBL program are directed to facilitate the groups rather than teach them. Facilitation requires careful observation of students' problem-solving processes in the contexts of their teams.

Tutors are asked to keep notes on their observations, and to use these notes to fill in a PBL evaluation on each student. The evaluation instrument is a reflection of a model of medical student learning followed by the developers of PBL.

In its instructions to tutors, the evaluation form states that observation of students during PBL have "…probably enabled you to come to know this student's strengths and weaknesses better than any other medical school faculty member…" (Scott, 2013)

Evaluations are intended to be based on observations made throughout the quarter by the tutors. It is reasonable to assume that each tutor observed each student carefully during each phase of each case.

Evaluations are filled out on paper forms that are handed to the PBL program office.

What follows are the evaluation items, including the performance anchors given to the tutors:

1. How would you rate this student's problem solving skills with respect to: (Circle one for each)

	Poor	**Fair**	**Good**	**Very Good**	**Excellent**
Reliability	Never completed assignments as agreed to				Always willing to assist others when appropriate
Efficiency	Contributions were rambling and disorganized				Contributions were always to the point
Analytic sense	Seldom identified new issues or relevant major concerns				Frequently contributed very insightful comments

2. How would you rate this student's developing clinical knowledgebase? (Circle one option for each)

Unsatisfactory. Needs work on acquiring, analyzing information.	Has basic data Needs work on organization & presentations.	Data complete & concise. Satisfactory organization & presentations.	Database & assessments are outstanding. Excellent presentations	Unable to evaluate

3. How would you rate this student's interpersonal relationships? (Circle one option)

Often discourteous. Non-empathetic. Put personal needs above group needs. Seemed reluctant to communicate.	Fair rapport, occasionally discourteous. Rarely communicative (seemed unwilling or unable)	Generally good rapport. Generally empathetic. Occasionally facilitated group communications.	Consistently courteous & empathetic. Gives group needs priority. Often facilitates communication.	Unable to evaluate

4. How would you rate this student's educational attitudes? (Circle one option)

Was often sullen, hostile, and argumentative. Reacted poorly to feedback. Irresponsible.	Responded to questions. Didn't volunteer. Rarely contributed to discussions. Marginally responsible	Good participation. Often contributed to discussions. Accepted feedback well. Responsible.	Excellent participation. Eager to learn. Stimulated the learning process. Extremely responsible.	Unable to evaluate

5. How would you rate this student's personal characteristics? (Circle one option)

Not well motivated. Avoided "doing" At times appeared disinterested.	Accepted average load of work.	Did all work expected. Often volunteered.	Worked exceptionally hard. Active leader. Sought new learning.	Unable to evaluate

6. If this student has any particularly noteworthy strengths PLEASE describe them below:

7. If this student has any areas needing improvement PLEASE describe them below:

OVERALL COURSE GRADE (CHECK ONE): PASS FAIL NOTE: Poor attendance, lack of significant, meaningful participation, or unprofessional behavior are grounds for failure.

Problem-Based Learning Student Survey

All PBL students were invited to complete an online survey about their opinions and attitudes toward their PBL experience. Response rates to this survey have consistently been above 60%, and sometimes as high as 80%.

The survey was administered using the University of Washington's Catalyst WebQ toolset, a web-based survey and assessment platform. Students accessed the survey by using their student network ID, so responses were not completely confidential. However, the identities of the students were not shared outside of the Director of Educational Evaluation's office.

Students were also invited to fill out a paper and pencil course evaluation administered by the University of Washington's central administration. Results of this survey are not part of this study.

From year to year, most of the survey items were identical. Included here are the items that were the same between the two cohorts studied.

Question 1:

Aspect	**Answer Choices**				
Opportunities for active participation:	Poor	Fair	Good	Very Good	Excellent
Opportunities to develop critical thinking skills:	Poor	Fair	Good	Very Good	Excellent
Web-based/electronic resources:	Poor	Fair	Good	Very Good	Excellent
Usefulness of the syllabus:	Poor	Fair	Good	Very Good	Excellent
Overall course rating:	Poor	Fair	Good	Very Good	Excellent

Question 2: By the end of the course, please rate the degree to which this course enabled you to achieve the following objectives:

Aspect	**Answer Choices**				
Identify and formulate a medical problem list:	Poor	Fair	Good	Very Good	Excellent
Know where/how to find the information you need:	Poor	Fair	Good	Very Good	Excellent
Differentiate between good and poor quality Internet resources:	Poor	Fair	Good	Very Good	Excellent
Formulate a differential diagnosis:	Poor	Fair	Good	Very Good	Excellent
Work effectively as a member of a simulated medical team, i.e., your group:	Poor	Fair	Good	Very Good	Excellent

Aspect	**Answer Choices**				
Communicate effectively to educate peers and patients:	Poor	Fair	Good	Very Good	Excellent

THE FOLLOWING BOXES ARE PLACES FOR YOU TO DESCRIBE THE MAJOR COURSE STRENGTHS AND YOUR RECOMMENDATIONS FOR IMPROVEMENT:

Question 3:
HB 559: (OPTIONAL) Strengths of the small group experiences:
(Please leave this comment box blank if you do not consider this category a course strength.)

Question 4:
HB 559: (OPTIONAL) Recommendations for improving the small group experiences:
(Please leave this comment box blank if you do not have a recommendation for this category.)

Question 5:
Which of the following options best describes your overall reaction to this quarter's PBL Component?

- o I expected a more valuable experience
- o About what I expected
- o Exceeded my expectations

Question 6:
What advice would you offer to next year's faculty regarding the Winter Quarter PBL Component?

- o Cut it
- o Keep it as it is
- o Expand it, with more cases, in the same amount of time
- o Expand it, with more cases, and more time

Question 7:
Which of the following options best describes your desires regarding having PBL in the curriculum?

- o I hope I never have another PBL experience
- o I'd like to have PBL deleted from the curriculum
- o I'd like to have the curriculum remain like it is, the same amount of PBL
- o I'd like to have a small amount of PBL added to the current curriculum
- o I'd like to have much more PBL, but not PBL exclusively
- o I'd like to have nothing but PBL

Question 8:
What is your opinion regarding the effect of your group being multidisciplinary (e.g., had both medical and PA students)?

- o Hindered your learning
- o Had no effect on your learning
- o Enhanced your learning
- o Not applicable - your group was not multidisciplinary

Question 9:
Which of the following options best describes the cumulative effect of this quarter's PBL experiences on your understanding of the clinical-decision making (CDM) process?

- o Had no effect on your understanding of the CDM process
- o Had a minimal effect, you developed a few new insights into the CDM process
- o Had a significant effect, your understanding of the CDM process was definitely enhanced

Question 10:
HB 559: Please describe as best you can how your learning in PBL differed from that in the traditional parts of your coursework:

Question 11:
We are interested in your opinion about the value of the end-of-case debriefing sessions to the development of your clinical decision-making (CDM) prowess. Please select the option below that best describes your opinion:

- o The debriefing sessions helped me learn about CDM. Definitely keep them
- o I have no opinion about the value of the debriefing sessions
- o The debriefing sessions added nothing to my CDM learning. Cut them

Question 12:
HB 559: What advice would you offer to next year's students about this course?

Question 13:
Please indicate which PBL group you were in and rate your PBL Small Group Tutor(s):

(*A list of the tutors appeared here. Students picked their tutor so that the questions that followed had their tutor's name*.)

Question 14: IF YOU WERE IN GROUP [group number appeared here], please provide feedback on [Tutor name appeared here] as your PBL tutor:

Aspect	**Answer Choices**				
Ability to facilitate the PBL process:	Poor	Fair	Good	Very Good	Excellent
Ability to make you feel comfortable in the group:	Poor	Fair	Good	Very Good	Excellent
Ability to clarify issues when group discussions seemed to bog down:	Poor	Fair	Good	Very Good	Excellent
Ability to allow your group the freedom to identify its own learning objectives:	Poor	Fair	Good	Very Good	Excellent
Keeping in mind that PBL tutors are trained to be more of an observer/facilitator and are cautioned NOT to instruct during the sessions, please rate the overall effectiveness of [tutor name].	Poor	Fair	Good	Very Good	Excellent

Question 15:
HB 559: Particular strengths of [*tutor name appears here*]:

Question 16:
HB 559: Suggestions for improvement for [*tutor name appears here*]:

Family Medicine Clerkship Performance Evaluations

All students in the MD program are required to complete at least one quarter in a Family Medicine clerkship. Usually this clerkship was completed in the year following PBL.

The Family Medicine Program communicates its evaluation criteria to students, so that they understand what is expected of them. Preceptors are encouraged to do informal, formative evaluations frequently throughout the quarter, always using the same criteria shown on the following pages.

The instructions on the evaluation form state:

> The Family Medicine Clerkship is a mastery-based required clerkship. Evaluation is primarily based on the student's performance in the last 2-3 weeks of the clerkship with possible exceptions involving unacceptable professional behavior. Review the anchors in each category and select the category that most closely mirrors the student's performance in that area. The anchors are not a checklist where all items are required to achieve a particular grade.

The Family Medicine Clerkship also includes a final exam, taken online, that assesses clinical skills and knowledge gained in the clerkship. Scores for this exam were not available for all subjects, and they are not included in this study.

CLINICAL SKILLS SECTION

I. **CLINICAL KNOWLEDGE AND SKILLS**	**1**	**2**	**3**	**4**	**5**
Knowledge in Subject Area: Includes level of knowledge and application to clinical problems.	Never demonstrates an understanding of basic principles. Never applies knowledge to specific patient conditions.	Inconsistently Demonstrates understanding of basic principles. Inconsistently applies knowledge to specific patient conditions.	Generally demonstrates understanding of basic principles. Generally applies knowledge to specific patient conditions.	Often demonstrates understanding of basic and some complex principles. Often applies knowledge to specific patient conditions.	Consistently demonstrates understanding of basic and most complex principles. Consistently applies knowledge to specific patient conditions.
Data Gathering Skills: Includes basic history and physical examination.	Never obtains basic history and physical	Inconsistently obtains basic history and physical.	Generally obtains basic history and physical.	Often obtains basic history and physical. Obtains some elements of more advanced history and physical.	Consistently obtains basic history and physical. Obtains elements of more advanced history and physical.
Clinical Skills: Includes oral case presentations, written or dictated notes, histories, physical exams and procedural skills.	Never communicates medical histories and physical exams in an organized or complete manner. Not attentive to patient comfort or dignity and demonstrates poor motor skills.	Inconsistently communicates medical histories and physical exams in an organized or complete manner. Inconsistently demonstrates good motor skills and inconsistently demonstrates good motor skills.	Generally communicates medical histories and physical exams in an organized or complete manner. Generally demonstrates good motor skills and generally demonstrates good motor skills.	Often communicates medical histories and physical exams in an organized or complete manner. Often demonstrates good motor skills and often demonstrates good motor skills.	Consistently communicates medical histories and physical exams in an organized or complete manner. Consistently demonstrates good motor skills. Consistently attentive to patient comfort or dignity.

II. PATIENT CARE SKILLS	**1**	**2**	**3**	**4**	**5**
Integration Skills: Includes problem-solving skills, ability to use data from patient interview, physical examination, and ancillary tests to identify major and minor patient problems in an organized and efficient manner.	Never independently identifies major patient problems. Unable to problem solve and organize issues efficiently.	Inconsistently able to independently identify and prioritize major problems. Inconsistently able to problem solve and organize efficiently.	Generally able to independently identify and prioritize major problems. Generally able to problem solve and organize efficiently.	Often is able to identify and prioritize all major and most minor patient problems. Often is able to problem solve and organize efficiently.	Consistently able to identify and prioritize all major and minor problems. Consistently able to problem solve and organize efficiently.
Management Skills: Includes order writing, initiative, practicality, and independence.	Never offers an Independent management plan or plan is unrealistic or illogical.	Inconsistently offers an Independent management plan and/or plan is often unrealistic or illogical.	Generally offers an Independent management plan that is realistic and logical.	Often offers an independent management plan that is logical and realistic.	Consistently offers an independent management plan that is logical and realistic and includes preventative counseling.
Patient Centered Care (PCC): Skills including: 1.Elicits and negotiates agenda for the patient; 2. Elicits the patient's perspective of their illness; and 3.Negotiates treatment plan with the patient	Never elicits and negotiates agenda with patients. Never elicits the patient's perspective of his/her illness. Never negotiates treatment plan with the patient. Never integrates biomedical and psychosocial perspective into care plan and patient management	Inconsistently elicits and negotiates agenda with patients. Inconsistently elicits the patient's perspective of his/her illness. Inconsistently negotiates treatment plan with the patient. Inconsistently integrates biomedical and psychosocial perspective into care plan and patient management.	Generally elicits and negotiates agenda for the patient. Generally elicits the patient's perspective of his/her illness. Generally negotiates treatment plan with the patient. Generally integrates biomedical and psychosocial perspectives into care plan and management of the patient.	Often elicits and negotiates agenda with the patient. Often elicits the patient's perspective of his/her illness. Often negotiates treatment plan with the patient. Often integrates biomedical and psychosocial perspectives into care plan and management.	Consistently elicits and negotiates agenda with the patient. Consistently elicits the patient's perspective of his/her illness. Consistently negotiates treatment plan with the patient. Consistently integrates biomedical and psychosocial perspectives into care plan and management.

III. Interpersonal Relationships	**1**	**2**	**3**	**4**	**5**
Communication Skills: Student's ability to communicate with patients, families, colleagues, and staff; Includes ability to modify communication style and ability to listen and constructively resolves conflicts.	Never communicates information effectively. Never has an awareness to modify communication style and content to situation. Unable to establish rapport. Unable to listen and be silent. Never culturally proficient.	Inconsistently communicates information effectively. Inconsistently has an awareness to modify communication style and content to situation. Inconsistently able to establish rapport. Inconsistently able to listen and be silent. Inconsistently culturally proficient.	Generally communicates information effectively. Generally modifies communication style and content to situation. Generally able to establish rapport. Generally able to listen and be silent. Generally culturally proficient.	Often communicates information. Often modifies communication style and content to the situation. Often able to establish rapport. Often able to listen and be silent. Often culturally proficient.	Consistently able to communicate information. Consistently able to modify communication style and content to the situation. Consistently able to establish rapport. Consistently able to listen and be silent. Consistently culturally proficient.
Relationships with Patients and Families: Includes courtesy, empathy, respect, compassion and understanding the patient's perspective.	Disrespectful, indifferent, callus, discourteous or condescending. Does not solicit the patient's perspective. Imposes own personal values on patient when in conflict with their own. Violates HIPPA including patient confidentiality. Inappropriate	Inconsistently shows respect, empathy and compassion. Inconsistently solicits the patient's perspective. Inconsistently respects patient's values or imposes own personal values on patient when in conflict with their own.	Generally demonstrates respect, empathy and compassion. Generally solicits the patient's perspective. Generally respects the patient's values, even when in conflict with their own.	Often demonstrates respect, empathy and compassion. Often able to solicit the patient's perspective. Often respects the patient's values even when in conflict with their own.	Consistently demonstrates respect, empathy and compassion. Consistently able to solicit the patient's perspective. Consistently respects the patient's values even when in conflict with their own.

	boundaries. Exhibits behavior that is potentially harmful to patients				
Professional Relationships: Ability to work collaboratively with team members including faculty staff and other students; courteous and cooperative attitude. Maintains composure in times of stress.	Never collaborates and/or establish appropriate relationships with team Never respects team members within and across specialties. Not compassionate when interacting with team. Never clarifies expectations or clinical responsibilities. Inappropriate boundaries. Disrespectful, indifferent, callus, discourteous or condescending	Inconsistently collaborates and/or establishes appropriate relationships with team. Inconsistently respects the roles of team members within and across specialties. Rarely is compassionate when interacting with team.	Generally collaborates and establishes appropriate relationships with team. Generally recognizes and respects roles of all team members within and across specialties. Generally is compassionate when interacting with team.	Collaborates well with entire team. Always recognizes and respects roles of team members within and across specialties. Often compassionate when interacting with team.	Collaborates effectively with entire team and seeks to improve team function. Consistently recognizes and respects roles of team members within and across specialties and works to improve team cohesion. Consistently compassionate when interacting with team.

IV. Personal Characteristics	**1**	**2**	**3**	**4**	**5**
Educational Attitudes: Includes active participation in learning, self-reflection and responsiveness to feedback and provides respectful and constructive feedback.	Never does what is required. Does not respond appropriately to feedback. Never reflects on their own knowledge base. Never participates in educational experiences Is not actively engaged in learning. Argumentative or hostile with feedback. Values self above others, sense of entitlement. Engages in destructive competition Feedback provided to others is not respectful.	Inconsistently does what is required. Inconsistently responds appropriately to feedback. Inconsistently reflects on their own knowledge base. Inconsistently participates in educational experiences. Inconsistently is actively engaged in learning.	Generally does what is required. Generally responds appropriately to feedback. Generally able to reflect on their own knowledge base. Generally participates in educational experiences. Generally is actively engaged in learning.	Often does what is required and often seeks additional learning opportunities beyond required level. Often seeks feedback and responds appropriately. Often is able to reflect on their own knowledge base. Often participates in Educational experiences. Consistently and actively engaged in learning.	Actively participates in all activities. Actively seeks feedback and responds appropriately. Initiates self-assessment and teaches others. Consistently participates in educational experiences. Consistently engaged in learning. Asks insightful questions, motivates others, and demonstrates leadership with individuals and in group settings.
Dependability and Responsibility: Includes attendance, preparation, and personal appearance. Maintains personal honor and integrity.	Frequently late without a legitimate reason or unprepared. Never follows through with assigned tasks. Not trusted to work independently.	Occasionally late or unprepared. Inconsistently follow through with assigned tasks. Rarely trusted to work Independently.	Generally on time and prepared. Generally follows through with assigned tasks. Generally trusted to work independently	Always on time and prepared. Follows through with assigned tasks and often volunteers additional effort to follow through with patient care.	Consistently on time and prepared for required and optional activities. Follows through with assigned tasks and consistently volunteers additional effort to follow through with patient care.

	Dishonest in any way. Does not maintain appropriate appearance. Absent without an excuse. Erratic or unpredictable behavior.		and knows limits and asks for help when needed.	Consistently trusted to work independently and knows limits and asks for help when needed.	Consistently trusted to work independently and knows limits and asks for help when needed.

PBL Follow-Up Survey

For approval to use student data, the UW Human Subjects Division required that all potential subjects be emailed with a notification of the study, and given a chance to opt out of the study.

The notification and opting in or out also included a follow-up survey to ask students if they thought that their PBL experience prepared them for success in their Family Medicine clerkships.

The survey was housed using the same web-based survey platform as the PBL Student Survey.

1. Please enter your name.

First Name: [TEXT BOX]

Last Name: [TEXT BOX]

2. Choose one option:

- ☐ I choose to opt out of the study, so that my student records will not be included in the analysis.
- ☐ I choose to allow my records to be included in the analysis. I understand that my records will be kept confidential and that my name will be replaced with a random number during the data analysis.

3. I also seek your reflections on your PBL experience at the UW School of Medicine by means of a survey that would take about two minutes to fill out.

Your responses will be kept confidential and your name will be replaced with a random number during the data analysis.

4. Please rate the degree to which you agree or disagree with this statement:

The 2nd year PBL course provided experiences that helped prepare me for clerkships.

- ☐ Strongly agree
- ☐ Agree
- ☐ Neither agree nor disagree
- ☐ Disagree
- ☐ Strongly disagree

5. If you'd like to comment on your answer, please do so here.

Rate the degree to which you think PBL helped to prepared you to do the following in your Family Medicine clerkship, by indicating whether you agree or disagree with the statement:

6. PBL helped prepare me to:

	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree
identify and fill gaps in my knowledge during my FM clerkship.					
use a clinical reasoning process to work through unfamiliar problems during my FM clerkship.					
learn from others in FM clerkship.					
ask productive and insightful questions during my FM clerkship.					
put my knowledge to use in the appropriate situations during my FM clerkship.					

7. If you'd like to comment on how PBL did or did not help prepare you to learn and perform during your Family Medicine clerkship, please do so here.

Chapter 3: Procedures and Quantitative Analysis

Selection and Informing of Subjects

The population being studied includes all University of Washington School of Medicine MD students who completed one quarter of PBL in their second year, and who then completed a one-quarter Family Medicine Clerkship in a subsequent quarter.

The study focuses on the two most recent cohorts for which PBL evaluation and Family Medicine Clerkship data were available. Names of students came from the PBL evaluations for Winter Quarter 2010 and Winter Quarter 2011. Each of the names was looked up in the UW Directory and on Google, to find their email addresses for use in informing subjects. About half of the email addresses could not be found, and they were eliminated as potential subjects.

All students with available email addresses were contacted and provided with information about the study, per UW Human Subjects Division requirements for informed consent. Potential subjects were directed to an online survey where they could choose to opt out of the study, or to opt in and complete a brief online survey about their PBL and Family Medicine clerkship experiences. Subjects who did not respond within two weeks were included in the study, per the information sent to them and per UW Human Subjects approval.

Sample Bias

Because the sample was not chosen at random, sample bias is a possibility.

Criteria for exclusion are:

- Student does not have a current, valid email address
- Student chose to opt out of the study

Fewer than 10 students per cohort year opted out of the study, and so opting out had a small effect on the overall maximum sample size of over 400 students. Most of the unused cases were excluded because a current email address could not be found. Whether the population members without current, findable email addresses

have characteristics different from those who did have findable email addresses is difficult to predict. The only way to know for sure if sample bias is present is to re-run the study with all students.

As explained later in this chapter, it was assumed that sample bias effects would be the same for both cohorts. As explained in the subsequent section **Descriptive Statistics and Comparisons of Means**, the descriptive statistics for the two cohorts showed no significant differences. However, as explained later in this chapter in a section titled **Differences in Correlations between Cohorts**, the two cohorts showed different correlational characteristics. The cohort with fewer missing values (2011) is assumed to have less sample bias in most parts of the following analysis.

Data Gathering and Data Entry

Problem-based learning scores and comments, along with the names and email addresses of the students, were entered into Excel from paper documents, and then checked to ensure accuracy. Each row in the Excel spreadsheets represented a subject, and each column represented an assessment item (variable).

The spreadsheets were handed to the UW School of Medicine, which replaced the names and email addresses with random ID numbers[5], and provided spreadsheets with the same ID numbers along with the following for each ID number:

- Year of entry into the MD program
- Gender
- Birth year
- MCAT scores
- Problem-Based Learning Evaluation scores
- Problem-Based Learning survey answers (filled out by students, evaluating their PBL experience)
- Clerkship quarter (the quarter in which students did the clerkships)
- Clerkship Evaluation scores

Rows and columns in the different spreadsheets were checked for consistency to ensure that they used the same ID numbers (rows) and the same variables (columns). Data were then pasted into the Data view in SPSS, variable by variable (column by column). Each variable was set up in SPSS using the appropriate type: numerical or string, nominal, ordinal, or scale. Data entry was re-checked by checking subject IDs and their corresponding variable values with the information in the spreadsheets provided.

Most of the variables use discreet ordinal scales, such as Likert scales or similar scales. These variables were set up in SPSS as numerical/ordinal.

[5] The link between ID numbers and student names is kept in a secure location at the UW School of Medicine

Table 4

Population and Sample Sizes

	Total Students completing PBL	MCAT scores, gender, age	% of N	PBL Evaluations (by tutors)	% of N	PBL Survey Responses (by students)	% of N	Follow Up Survey Responses	% of N	Clerkship Evaluations (done by preceptors)	**% of N**
2010 PBL Cohort	N = 230	n = 153	67	n = 132	57	n = 50	22	n = 35	15	n = 113	49
2011 PBL Cohort	N = 211	n = 131	62	n = 132	63	n = 81	38	n = 36	17	n = 134	64
	N = 441	n = 284	64	n = 264	60	n = 131	30	n = 71	16	n = 247	56

Descriptive Statistics and Comparisons of Means

Means, standard deviations, kurtosis, and skewness was calculated for all numerical/scale (e.g., MCAT scores and birth years) and numerical/ordinal variables (e.g., clerkship ratings).

Table 5: Ages of Subjects during PBL

	Mean age during PBL	Mode age during PBL	Min/max age during PBL	Skewness
PBL 2010 cohort	26	25	21/43	-2.4
PBL 2011 cohort	27	25	21/43	-1.8

Gender distribution in the sample is 52.6 % female and 46.7 % male, with gender information missing for two subjects. The 2011 cohort sample has a higher proportion of females than the 2010 cohort sample.

Table 6

Proportions of Male and Female Subjects in the sample

		Gender %	
		F	M
Study Cohort	2010	49.7	50.3
	2011	56.8	43.2

MCAT mean scores are shown below. A t-test found no significant difference in mean MCAT scores between cohorts.

Table 7

Comparison of MCAT Scores between Cohorts

	Study Cohort	N	Mean	Std. Deviation	Std. Error Mean
MCATV	2010	153	10.20	1.536	.124
	2011	131	9.98	1.428	.125
MCATPhys	2010	153	10.31	1.951	.158
	2011	131	9.93	1.679	.147
MCATBio	2010	153	10.92	1.437	.116
	2011	131	10.79	1.641	.143

A t-test comparing MCAT scores shows a small and insignificant bias toward males, which is consistent with a known male bias in the MCAT (Jaschik, 2011). Scores are shown below.

Table 8

Comparison of MCAT Scores between Genders

	Gender	N	Mean	Std. Deviation	Std. Error Mean
MCATV	F	151	9.91	1.492	.121
	M	133	10.31	1.463	.127
MCATPhys	F	151	9.68	1.715	.140
	M	133	10.65	1.838	.159
MCATBio	F	151	10.56	1.258	.102
	M	133	11.20	1.738	.151

Comparison of Sample and Population MCAT Distributions

A comparison of sample and population (AAMC, 2012) MCAT distributions shows that the sample had higher mean scores and less variation than the population. Differences between the sample and total population are expected, because the student admission process is not based on random sampling, and because the sample used in this study was not randomly drawn from students who entered the MD program.

Table 9

Comparison of Sample and Population (AAMC, 2012) MCAT Scores

	Study Cohort	n	S. Mean	Pop. Mean	Sample S.D.	Pop. S.D.
MCATV	2010	153	10.20	2007: 8.0	1.5	2007: 2.6
	2011	131	9.98	2008: 8.0	1.4	2008: 2.5
MCATPhys	2010	153	10.31	2007: 8.4	2.0	2007: 2.4
	2011	131	9.93	2008: 8.2	1.7	2008: 2.4
MCATBio	2010	153	10.92	2007: 8.8	1.4	2007: 2.5
	2011	131	10.79	2008: 8.7	1.6	2008: 2.5

Distributions and Comparisons of Means for Discreet Variables

Variables in the PBL evaluations, PBL surveys, Clerkship evaluations, and PBL follow-up surveys are discreet. Some are categorical, such as the geographic region of a clerkship or the group in which a subject took PBL.

Most, however, are ordinal scales with three to five choices, and a higher number indicating higher levels of performance or higher levels of agreement. Nearly all of the ordinal scale variables show a strong ceiling effect, in which the mode is the highest rating.

While all of the ordinal distributions are skewed, kurtosis on all is between -1 and 1, confirming that all have single peaks, and that normality can be assumed in limited circumstances. To compare the two cohorts, means of the ordinal variables were compared using t-tests.[6] No significant differences were found between cohorts.

More detail about the categorical and ordinal variables and distributions is provided in the sections about each

Exploratory Factor Analysis

All of the measures of student knowledge and skills (MCAT scores, PBL Evaluation scores, and FM Clerkship Evaluation Scores) were run through Principle Component Analysis in SPSS.

Four factors were extracted, and the division between factors reflected that the three measures focus on three different areas of learning and achievement.

In PBL and Clerkship, items for knowledge and development of knowledge are in the same factor as all (for PBL) and many (for Clerkship) skills items. In PBL, Educational Attitudes are in the same factor as all other items, while in Clerkship, Educational Attitudes are in a separate factor along with Relationships with Patients, Professional Relationships, and Dependability and Responsibility.

[6] A t-test assumes one continuous, normally distributed variable and one categorical variable. While the ordinal variables in this study are neither continuous nor normal, t-tests were used as a proxy for comparing average values between cohorts.

Table 10

Rotated (Varimax) Component Matrix for all Items that Evaluate Student Learning and Achievement

	Component			
	1	2	3	4
MCATV				.392
MCATPhys				.806
MCATBio				.814
PBLReliability		.727		
PBLEfficiency		.800		
PBLAnalyticsense		.754		
PBLDevelopingCKB		.669		
PBLInterpersonalrelationships		.733		
PBLEducationaAttitudes		.802		
PBLPersonalCharacteristics		.775		
ClerkshipKnowledgeofSubject	.728			
ClerkshipDataGatheringSkills	.706		.319	
ClerkshipClinicalReportingSkills	.726			
ClerkshipIntegrationSkills_A	.766			
ClerkshipManagementSkills_A	.776			
ClerkshipPatientCenteredCareSkills_A	.547		.418	
ClerkshipCommunicationSkills	.671		.367	
ClerkshipRelationshipswithPatients	.309		.733	
ClerkshipProfessionalRelationships_A			.712	
ClerkshipEducationalAttitudes	.461		.615	
ClerkshipDependabilityandResponsibility	.422		.653	

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
Rotation converged in 6 iterations.

Exploratory Correlation Analysis

Limitations of Correlations

By themselves, correlations between variables within a sample are not proof that a relationship of any type exists in the general population. Correlations can arise from sampling error or from pure coincidence. Proof of a relationship requires replication along with a chain of evidence that explains the mechanism for the relationship. Proof of cause-effect relationships requires evidence from experimentation. Proof of non-causal relationships requires an evidence-based theory that can predict the correlation in similar situations.

A correlation that meets a significance level of .05 or .01 can be expected to occur from sampling error five times out of 100 or one time out of 100, respectively. The exploratory correlation analysis in this study involved over 200 different pairs of variables using the same sample. While these separate correlations do not represent a sampling distribution, they were done on variables highly co-variant within the different evaluations (PBL and Clerkship). Thus, it is not surprising that many correlations were found.

This paper will argue that some of the correlations found in this study are supported by evidence-based theory and by similarities between the different items, and that these correlations may lead to new insight into the development of adaptive expertise in physicians.

Criteria for Rejecting the Null Hypothesis

To reduce the chance of rejecting the null on correlations that are due to error or bias, all correlations used as the basis for this study must meet these criteria in order to reject the hypothesis that no relationship exists:

- The correlation appears when combining both cohorts, such that errors in the different cohorts have a greater chance of canceling each other;
- Evidence-based theory can help explain for the relationship.

Where these two criteria are met, additional evidence will be sought by looking for comments written by students whose scores fit the correlation pattern or by their instructors or preceptors, to see if they provide insight as to why the relationship may exist.

Example of Accepting the Null (Rejecting the Correlation)

Below is a negative correlation between a rating for Clerkship Management Skills (the ability to manage a case), and response on an item in the PBL Survey, in which students rated the degree to which PBL enabled the respondent to know where/how to find needed information. Students who rate PBL highly for helping them know where to find information were rated lower on clerkship management skills.

Table 11

A PBL Survey Item * Clerkship Management Skills Rating

		Eval_2b_Knowwherehowtofindtheinformationyouneed	ClerkshipManagementSkills_A
Eval_2b_Knowwherehowtofindtheinformationyouneed	Pearson	1	-.265*
	Sig. (2-tailed)		.017
	N	81	81
ClerkshipManagementSkills_A	Pearson	-.265*	1
	Sig. (2-tailed)	.017	
	N	81	134

* Correlation is significant at the 0.05 level (2-tailed).

Data are available for the 2011 cohort only, and 39.6% of cases in 2011 are missing. The author has found no evidence-based theory to explain this relationship. Therefore, the null hypothesis is accepted.

Understanding and Interpreting Bivariate Correlations Involving Ordinal Variables

When comparing two continuous variables, a correlation can be seen on a scatterplot on Cartesian (x/y) coordinates as a sloping linear pattern. If the two variables are uncorrelated, then the pattern may appear horizontal, spherical, or random.

When comparing two ordinal variables, or when comparing an ordinal variable to a continuous variable, a correlation can be seen in a crosstabulation.

Below is a cross tabulation between MCAT Verbal Reasoning scores and the scale for Analytic Sense in the PBL Evaluations. A correlation was found; Pearson coefficient is .166 (weak), and the significance level is .01. If no correlation existed between the variables *MCAT V* and *PBLAnalyticSense*, then the "line of best fit" between modes in the distribution in each level of *PBLAnalyticSense* would be horizontal. But the line of best fit between the modes slopes downward, toward the higher MCATV scores as it goes toward higher PBL Analytic Sense scores.

Table 12

MCATV*PBL Analytic Sense, 2011 Cohort

		PBLAnalyticsense				
		Fair	Good	Very good	Excellent	Total
MCATV	5	0	0	1	0	1
	6	0	0	1	3	4
	7	0	1	2	0	3
	8	1	2	13	13	29
	9	0	5	18	26	49
	10	0	8	25	34	67
	11	0	3	24	48	75
	12	0	2	4	13	19
	13	0	1	2	10	13
	14	0	0	0	2	2
Total		1	22	90	149	262

Below is a correlation analysis for two ordinal variables, indicating no statistically significant correlation.

Table 13

PBL Analytic Sense * Clerkship Patient Centered Care, 2010 Cohort

		PBLAnalyticsense	ClerkshipPatientCenteredCareSkills
PBLAnalyticsense	Pearson Correlation	1	-.003
	Sig. (2-tailed)		.979
	N	132	94
ClerkshipPatientCenteredCareSkills	Pearson Correlation	-.003	1
	Sig. (2-tailed)	.979	
	N	94	113

In the cross tabulation, the line between modes is horizontal.

Table 14

Crosstabulation, PBL Analytic Sense * Clerkship Patient Centered Care, 2010 Cohort

		Inconsistently elicits , negotiates, integrates	Generally elicits , negotiates, integrates	Often elicits , negotiates, integrates	Always elicits , negotiates, integrates	Total
PBLAnalyticsense	Fair	0	0	0	1	1
	Good	0	0	5	3	8
	Very good	0	1	15	14	30
	Excellent	1	1	25	28	55
Total		1	2	45	46	94

Effect Sizes and Interpretation of Effect Sizes

Effect sizes for all correlations found are small. With ordinal variables, interpreting the Pearson coefficient as the slope of a linear relationship does not have as much meaning as for continuous variables, because a .21 or .25 difference between levels does not exist. It is more valuable to use the square of the Pearson coefficient (R^2, or the coefficient of determination) as the percentage of variation explained by the relationship.

For example, for PBL Analytic Sense * Clerkship Patient Centered Care in the 2011 cohort:

$$R = .246$$
$$.246^2 = .06$$

Thus, the relationship explains 6% of the total variation in each variable. This is a small amount of variation. However, development of clinical knowledge and clinical skills is a complex phenomenon and involves social, cognitive, and affective factors. Considering that about a year passes between PBL and the Family Medicine Clerkship, and given all of the factors in play in the intervening time, accounting for 6% of variation in the Clerkship with a PBL evaluation item is a meaningful finding.

Starting Hypotheses

The present study is interested in understanding components of developing clinical skills in medical students. The centerpiece of the study is a qualitative evaluation of knowledge, skills, and attitudes of medical students during a family medicine clerkship. To better understand the components of skills and knowledge measured by this assessment, its items will be correlated with similar items for the same students, done about a year earlier in another contextual learning environment (PBL).

Starting Hypotheses

H_o: No significant correlations exist between PBL evaluation items and Clerkship evaluation items

H_1: Significant correlations exist between PBL evaluation items and Clerkship evaluation items

Exploratory Nature of the Study

The study is exploratory in that begins with no assumptions about which relationships between items will be found. Instead, the study will first determine whether any significant correlations exist. If they do exist, evidence will guide further hypotheses.

Exploratory Correlation: PBL and Clerkship Evaluations

All seven PBL Evaluation items were crossed with all eleven Clerkship Evaluation items. This section will discuss the procedures and results. Following sections will look at possible confounding factors, and will then look in detail at the content of the correlated PBL and Clerkship items.

Procedure in SPSS

Using the Bivariate Correlation function in SPEE, all PBL Evaluation and Clerkship Evaluation items were selected. The Pearson coefficient was used rather than Spearman or Kendall's tau-b because the relationships are assumed to be linear.

Cases were excluded pairwise, meaning that only complete pairs were used.

Results

Eleven correlations were found at the .05 significance level. This is nearly three times the number of correlations that would be expected from sampling error alone (77 combinations x .05 = 3.85).

One correlation was found at the .01 significance level.

Differences in Correlations between Cohorts

To check for the possibility that the correlations could be due to error, correlations for the 2010 cohort were compared to correlations for the 2011 cohort. Overall, the correlations in the two cohorts are different. This is an indication that some of the correlations might be due to error. Since the sample was not randomly drawn (inclusion was based on the availability of a current email address), it might be more precise to say that the differences may be due to differences in sampling bias.

However, it is likely that the 2011 cohort sample is less biased than the 2011 cohort sample, because the 2011 sample has significantly fewer missing values. (Any value in one measure that does not have a corresponding value in another measure is dropped, and counted as a missing value.)

The 2010 cohort has 35.9% missing values, while the 2011 cohort has 1.5 % missing values. Thus, 2011 has fewer missing values for PBL*Clerkship Evaluation correlations by more than a factor of 20.

Table 15

Missing Values in the PBL * Clerkship Correlations for 2010 Cohort

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
PBLEducationaAttitudes * ClerkshipEducationalAttitudes	98	64.1%	55	35.9%	153	100.0%

Table 16

Missing Values in the PBL * Clerkship Correlations for 2011 Cohort

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
PBLAnalyticsense * ClerkshipPatientCenteredCareSkills	132	98.5%	2	1.5%	134	100.0%

The results of all correlations, for the 2010 and 2011 samples combined, between the PBL Evaluation items and the Clerkship Items are shown on the following page.

Table 17: Correlation of PBL Evaluation Items * Clerkship Evaluation Items, 2010 and 2011 Samples Combined

		Knowledge	Data Gathering Skills	Clinical Reporting Skills	Integration Skills	Management Skills	Patient Centered Care Skills	Communication Skills	Relationships with Patients	Professional Relationships	Educational Attitudes	Dependability and Responsibility
PBLReliability	R[1]	.045	.022	-.005	.106	.055	.055	.147*	.053	.073	.118	.157*
	Sig.[2]	.497	.742	.943	.111	.411	.411	.027	.431	.277	.077	.019
	N	226	226	226	226	226	226	226	226	226	226	226
PBLEfficiency	R[1]	.050	-.049	.041	.106	.018	.018	.094	-.003	.030	.110	.094
	Sig[2]	.455	.465	.542	.111	.789	.789	.161	.962	.648	.099	.159
	N	226	226	226	226	226	226	226	226	226	226	226
PBLAnalyticsense	R[1]	.136*	.040	.090	.131*	.134*	.134*	.072	-.030	.063	.061	.138*
	Sig.[2]	.041	.551	.179	.049	.044	.044	.283	.652	.348	.358	.039
	N	226	226	226	226	226	226	226	226	226	226	226
PBLDevelopingCKB	R[1]	.125	-.005	.061	.096	.033	.033	.066	.032	.035	.157*	.153*
	Sig.[2]	.059	.945	.354	.148	.618	.618	.320	.626	.597	.017	.020
	N	230	230	230	230	230	230	230	230	230	230	230
PBLInterpersonalrelationships	R[1]	.019	-.053	.104	.050	.015	.015	.083	.061	.084	.099	.054
	Sig.[2]	.776	.426	.115	.450	.827	.827	.209	.358	.203	.136	.413
	N	230	230	230	230	230	230	230	230	230	230	230
PBLEducationaAttitudes	R[1]	.084	.026	.010	.105	.047	.047	.172**	.091	.098	.137*	.119
	Sig.[2]	.206	.690	.879	.111	.478	.478	.009	.171	.136	.038	.072
	N	230	230	230	230	230	230	230	230	230	230	230
PBLPersonalCharacteristics	R[1]	.132*	-.020	.081	.085	.023	.023	.126	.054	.034	.078	.051
	Sig.[2]	.046	.764	.223	.198	.734	.734	.056	.417	.604	.238	.438
	N	230	230	230	230	230	230	230	230	230	230	230

[1] Pearson
[2] Two-tailed

Variables of Interest

Among the twelve variables in statistically significant correlations, PBL Analytic Sense stands out as being correlated with the greatest number of variables, and as spanning the widest range of domains.

PBL Analytic Sense and its relationships with Clerkship items will become the focus of the rest of this study.

Table 18

PBL * Clerkship, Statistically Significant Correlations Only

		Knowledge	Integration Skills	Management Skills	Patient Centered Care Skills	Communication Skills	Educational Attitudes	Dependability and Responsibility
PBLReliability	R[1]					.147*		.157*
	Sig.[2]					.027		.019
	N					226		226
PBLAnalyticsense	**R[1]**	**.136***	**.131***	**.134***	**.134***			**.138***
	Sig.[2]	**.041**	**.049**	**.044**	**.044**			**.039**
	N	**226**	**226**	**226**	**226**			**226**
PBLDevelopingCKB	R[1]						.157*	.153*
	Sig.[2]						.017	.020
	N						230	230
PBLEducationaAttitudes	R[1]					.172**	.137*	
	Sig.[2]					.009	.038	
	N					230	230	
PBLPersonalCharacteristics	R[1]	.132*						
	Sig.[2]	.046						
	N	230						

Post-Hoc Estimation Statistical Power

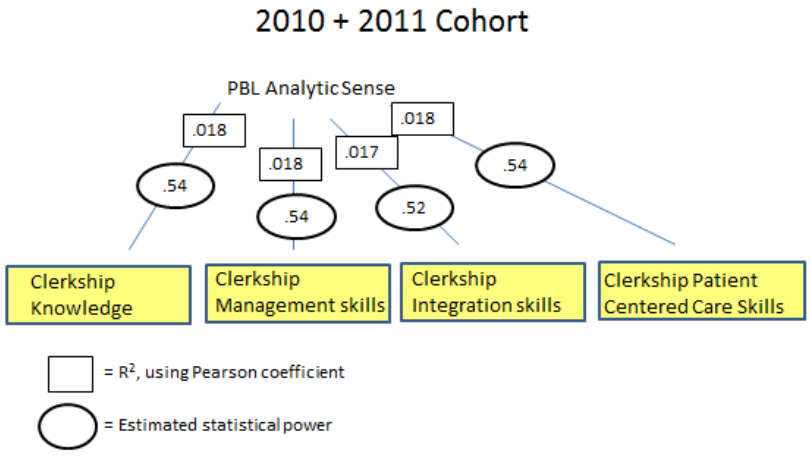
Statistical power is the probability of not committing a Type II error. For correlations, it can be calculated from the square of the Pearson coefficient, the sample size, and the significance level.

Statistical power assumes that a sample is random. The sample for this study does not meet that assumption, and so a calculation of power is only an estimate.

Using an online calculator for multiple regression using Pearson's R (Soper, undated), and setting the number of predictors to one, an estimate of power for each correlation was calculated. Power, along with the hypothesized relationships between different items can be seen of the following hypothesis map.

Note that power for all correlations is barely over .5, far lower than the .8 that most researchers consider as the minimum acceptable power.

Figure 1: Hypothesized Relationships between Items, 2010 + 2011 Cohorts

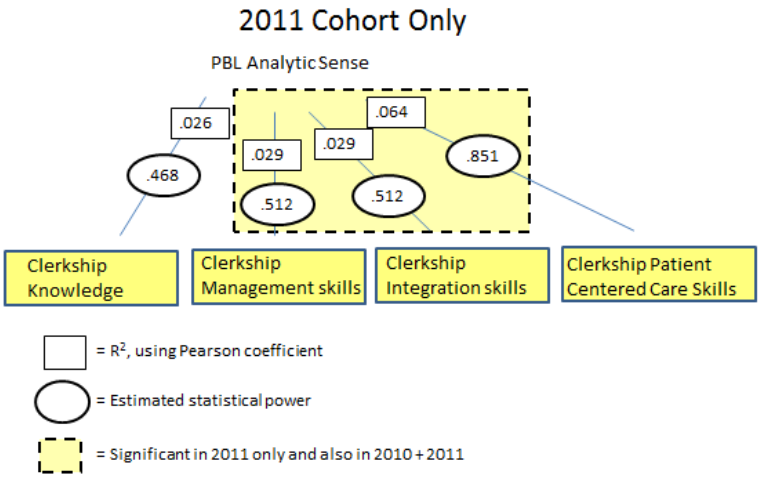


Examination of 2011 Cohort Data

Because the 2011 cohort sample may be less biased than the 2010 sample, power was estimated for correlations in the 2011 sample only.

Statistical power for PBL Analytic Sense * Clerkship Patient Centered Care Skills in the 2011 sample is .851.

Figure 2: Hypothesized Relationships between Items, 2011 Cohort Only



Justification for Further Focusing of the Study

Looking back at the factor analysis in Table 10, of the five Clerkship Evaluation items correlated with PBL Analytic Sense, four of the items are in Factor 1, while one item (Dependability and Responsibility) is in Factor 3.

The four items in Factor 1 are most closely related to clinical problem solving, while the one item in Factor 3 is most closely related to social skills and values.

To focus the analysis on transfer of clinical problem-solving skills, the item Dependability and Responsibility will be dropped from the analysis. However, it should be considered in future studies.

Table 19

Clerkship Factors for Variables of Interest

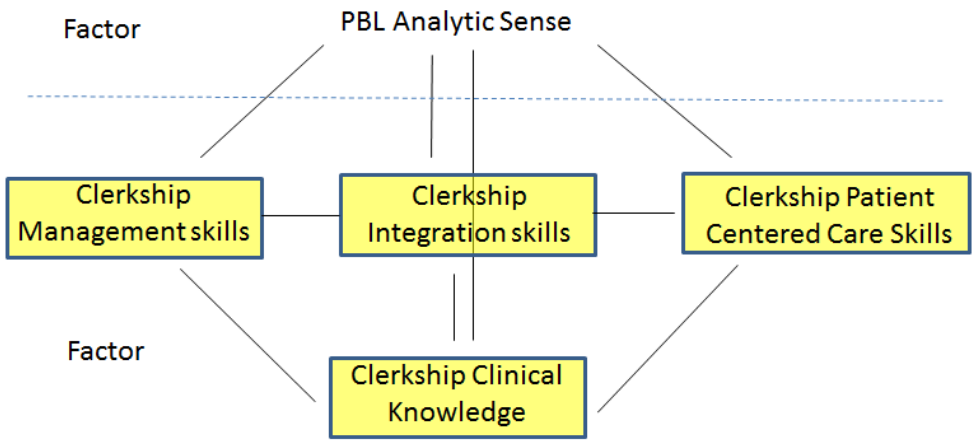
		Clerkship Factor				
		1				3
		Knowledge	Integration	Mgt.	PCC	D&R
PBL Analytic Sense	**R**[1]	.136*	.131*	.134*	.134*	.138*
	Sig.[2]	.041	.049	.044	.044	.039
	N	226	226	226	226	226

New Hypotheses

The null hypothesis (no significant correlations between PBL Clerkship evaluation items) cannot be rejected based on correlational analysis alone. The next steps in the investigation are to consider how rater bias and reliability may have affected the statistical outcomes, and then to consider the theory that may explain the relationships.

However, information from exploratory correlational analysis allows a new and more detailed hypothesis that includes factors and relationships between variables. The diagram below shows PBL Analytic Sense being correlated with four Clerkship Evaluation items. All four Clerkship items are within one factor and are highly correlated with one another.

Figure 3: Hypothesized Relationship between Factors and Items



$H2_o$: The factors and correlations shown do *not* exist

$H2_1$: The factors and correlations shown *do* exist

To test these hypotheses, the analysis will now turn to possible sources of bias or error that could be producing the result.

Rater Bias and other Confounding Factors in Evaluation Scores

The investigation will now turn to the possibility that the factors and correlations may be significantly affected by rater bias.

The PBL and Clerkship evaluations are designed to reflect student performance. However, they require human raters who may not interpret and rate performances consistently. Inter-rater reliability and rater bias were not tested directly and so cannot be measured directly.

For PBL and for Clerkship evaluations, differences in scores between groups will be used as a proxy for inter-rater variations and rater bias. A lack of variation will be used as a basis to assume that inter-rater reliability and rater bias are not significant factors in the variations of scores.

The analysis will look for:

- Differences in Analytic Sense scores between group size;
- Differences Analytic Sense between genders;
- Correlations between Analytic Sense and student ratings of their instructors.

If the differences in scores between groups are insignificant, score differences between group sizes will be interpreted as differences in student behavior in different social settings.

Differences between genders will be interpreted as possible evidence of gender bias.

Correlations between student ratings of their instructors and PBL Analytic Sense will be interpreted as possible evidence of rater bias in favor of students who may have better relationships with their tutors.

Difficulties with Inconsistent Group Sample Sizes

The sample is not stratified in a way that random subjects are chosen from each group. Of the 27 groups, a few of them have eight out of the ten possible members, while many only have one or two members. This makes comparing groups difficult at best. Also, a Chi-Square test on the raw data is not possible because too few students have low scores; too many cells in the crosstabulation will have 0-4 subjects. (For Chi-Square, best practice is to have a count of at least five in each cell.)

Small groups were combined, on the theory that combining incomplete groups will show a regression to a consistent that looks the same as a typical complete group. Combinations were made so that these characteristics were always kept intact:

- Cohorts were kept separate;
- Groups with eight MD students and two PA students were never combined with other group compositions;
- Groups with fewer or more than eight MD students and at least one PA students were never combined with other group compositions;
- Groups with no PA students were never combined with other group compositions.

Also, to meet the conditions of a Chi-Square test, lower scores were consolidated so that Poor, Fair, Good, and Very Good were combined. Thus, the test will only look at the proportion of Good and Very Good ratings.

A Chi-Square test was run to compare proportions of consolidated scores in the consolidated groups. Two of the cells had fewer than five subjects, and SPSS noted that four cells (25.0%) have expected count less than 5. The minimum expected count is 2.58. However, SPSS allowed the test to continue.

While differences between groups are visible in the bar chart, the Chi-Square indicates they are not statistically significant.

Table 20

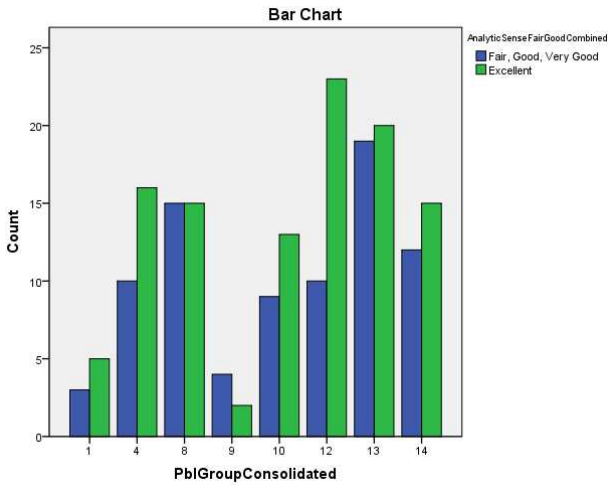
Chi-Square on Consolidated PBL Groups and Consolidated Analytic Sense Scores

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	5.043[a]	7	.655
Likelihood Ratio	5.106	7	.647
Linear-by-Linear Association	.043	1	.835
N of Valid Cases	191		

a. 4 cells (25.0%) have expected count less than 5. The minimum expected count is 2.58.

Figure 4

Proportions of Consolidated Analytic Sense Scores across Consolidated PBL Groups



A Chi-Square test was also run to compare the proportions of scores in three types of groups:

- **Type 1:** 8 MD students and 2 PA students
- **Type 2:** 9 or fewer MD students and at least one PA student
- **Type 3:** No PA students

None of the cells had counts less than five, and no significant differences were found.

Table 21

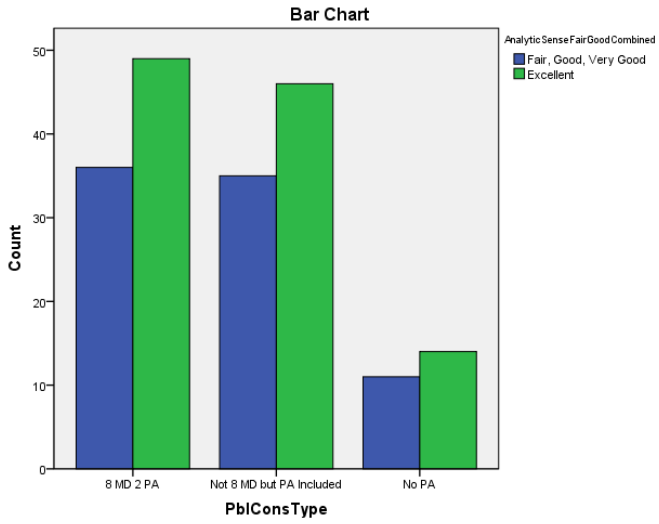
Chi-Square on Consolidated PBL Group Type and Consolidated Analytic Sense Scores

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	.026[a]	2	.987
Likelihood Ratio	.026	2	.987
Linear-by-Linear Association	.026	1	.873
N of Valid Cases	191		

0 cells (.0%) have expected count less than 5. The minimum expected count is 10.73.

Figure 5

Proportions of Consolidated Analytic Sense Scores across Consolidated PBL Group Types



Comparison of Scores for Different PBL Group Sizes

A Chi-Square test of different group sizes showed no significant differences.

Comparison of PBL Scores across Genders

A Chi-Square test using consolidated PBL Analytic Sense scores indicted no statistically significant difference in Analytic Sense scores between genders. A bar chart also shows no significant difference.

Student Ratings of Tutors

Student ratings of their tutors were compared with their PBL Evaluation scores using a bivariate correlation. This will be considered as a proxy for whether tutors consistently followed guidelines for observing students.

Table 22

PBL Survey Items that Evaluated Tutors

Aspect	Answer Choices				
Ability to facilitate the PBL process:	Poor	Fair	Good	Very Good	Excellent
Ability to make you feel comfortable in the group:	Poor	Fair	Good	Very Good	Excellent
Ability to clarify issues when group discussions seemed to bog down:	Poor	Fair	Good	Very Good	Excellent
Ability to allow your group the freedom to identify its own learning objectives:	Poor	Fair	Good	Very Good	Excellent
Keeping in mind that PBL tutors are trained to be more of an observer/facilitator and are cautioned NOT to instruct during the sessions, please rate the overall effectiveness of [tutor name].	Poor	Fair	Good	Very Good	Excellent

One weak (R=.236) correlation was found, between *PBL Personal Characteristics* and *Ability to allow your group the freedom to identify its own learning objectives*. Given that this was the only correlation and given that it does not involve the PBL variable *Analytic Sense*, it will be considered as insignificant for the final analysis.

Factor Analysis of PBL-Related Variables

To gage the amount that the PBL Evaluation item score variation may be influenced by variation in student opinions of their instructors, a factor analysis was run PBL Evaluation items along with PBL Survey instructor ratings. The PBL Evaluation items are found to be in a separate factor from the instructor ratings.

Table 23

Rotated Component Matrix (Varimax) Showing PBL Variables

	Component			
	1	2	3	4
PBLGroupSize			.807	
PBLGroupPAStudentsingroup				.793
PBLReliability	.704			
PBLEfficiency	.825			
PBLAnalyticsense	.786			
AnalyticSenseFairGoodCombined	.776			
PBLDevelopingCKB	.738			
PBLInterpersonalrelationships	.756			
PBLEducationaAttitudes	.818			
PBLPersonalCharacteristics	.802			
Eval_14a_AbilitytoFacilitate		.919		
Eval_14b_AbilitytoMakeFeelComfortable		.859		
Eval_14c_AbilitytoClarifyIssues		.796		
Eval_14d_AbilityToAllowIdentifyOwnLearning		.835		
Eval_14e_OverallInstructorRating		.881		

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
Rotation converged in 6 iterations.

Conclusion: Rater Bias and PBL Evaluation Scores

This study will assume that rater bias is *not* a significant source of variation in PBL Analytic Sense scores. Furthermore, gender, group type, and group size are not significant sources of variation in PBL Analytic Sense scores.

Clerkship Rater Bias

As with inter-rater reliability for PBL Evaluations, inter-rater reliability across Clerkship raters was not directly measured. The search for evidence of rater bias will start with a search for evidence of differences in scores across groups.

Differences across Clerkship Types and Regions

The clerkship scores were linked to clerkship types and to geographic regions.

Clerkship Type Codes Used in SPSS

1. Residency
2. Community

Chi-Square tests found no significant differences in scores between Clerkship Types for variables of interest: Integration, Management, Patient-Centered Care, and Knowledge.

Regions/Location Codes Used in SPSS

1. Idaho
2. Eastern Washington
3. Western Washington
4. Montana
5. University of Washington
6. Alaska

No significant differences in scores were found between Clerkship regions. However, to meet the cell value requirements for Chi-Square, all the Clerkship variables had to be consolidated to two levels (4 and 5), and WA and Alaska had to be combined to meet the cell value requirements of the Chi-Square test.

Differences in Clerkship Evaluation Scores between Genders

A Chi-Square comparison of male and female scores of the variables of interest reveals no significant differences.

To meet cell population requirements of the Chi-Square test, the variable *Patient Centered Care Skills* had to be consolidated into two levels. The other three variables did not require consolidation.

Quarters between PBL and Clerkship

Most students complete their Family Medicine Clerkship in the year following PBL. However, some students begin their clerkship in the quarter immediately following PBL, and some begin their clerkship more than a year after PBL.

A correlation was run between all Clerkship Evaluation variables and the variable Quarters between PBL and Clerkship.

Only one correlation was found, a weak one (R .173, sig .01) between Knowledge of Subject and Quarters between PBL and Clerkship. This may be due to additional time to learn about the subject matter in different contexts. It may also indicate that while knowledge increases over time in the MD program, clinical skills might not increase at the same rate.

Table 24

Quarters between PBL and Clerkship * Clerkship Knowledge of Subject

		ClerkshipQuartersBetween	ClerkshipKnowledgeofSubject
ClerkshipQuartersBetween	Pearson Correlation	1	.173**
	Sig. (2-tailed)		.007
	N	244	244
ClerkshipKnowledgeofSubject	Pearson Correlation	.173**	1
	Sig. (2-tailed)	.007	
	N	244	247

**Correlation is significant at the 0.01 level (2-tailed).

Conclusion: Rater Bias Not Significant

Results of the Chi-Square and correlation tests suggest that rater bias is not a significant factor in PBL or Clerkship scores for the variables of interest.

For both Problem-Based Learning and Clerkship Evaluation item scores, this study will assume that variations in scores are due mostly to differences in student behavior rather than differences in raters or groups.

The analysis now turns to the content of the items of interest, to understand which aspects of knowledge and skills may be correlated. Then it will consider whether evidence-based theory supports rejection of the null hypothesis.

Chapter 4: Analysis of Common Elements in Item Content

Quantitative analysis suggests that PBL Analytic Sense may be correlated with the following Clerkship Evaluation items:

- Knowledge of Subject
- Integration Skills
- Management Skills
- Patient-Centered Care Skills

Furthermore, factor analysis shows that all four of the Clerkship items listed above are in the same factor, along with other items related to clinical problem-solving.

The analysis will now turn to an ontological analysis of the content of the correlated items, to see if any clear commonalities across the items emerge. Commonalities may provide clues to identify hidden factors.

The analysis is ontological in that it looks at the intended meanings of the items, in the context of surrounding items that are in the same factor, or that are correlated.

Limitations of the Ontological Analysis

This analysis was conducted by one person – the author of this paper. Therefore, meanings of textual components as well as meanings of the entire picture are from the point of view of one researcher.

The analysis would be more reliable if it were validated by people who were involved in rating students in PBL and in the Clerkships. However, the one researcher conducting this analysis is well versed in the language of PBL and of competency-based assessment, and validity is improved by that knowledge.

Elements of the Ontology

Behavioral Anchors for Analytic Sense in the PBL Evaluation

In the PBL Evaluation, Analytic Sense is treated as a facet of problem-solving skills. Within problem-solving skills, it is differentiated from *Reliability* and *Efficiency*.

The PBL Evaluation form provides behavioral anchors for Poor and Excellent ratings. Anchors for ratings between Poor and Excellent must be interpolated.

Table 25: Content of Item 1 in the PBL Evaluation

8. How would you rate this student's problem solving skills with respect to: (Circle one for each)

	Poor	Fair	Good	Very Good	Excellent
Reliability	Never completed assignments as agreed to				Always willing to assist others when appropriate[7]
Efficiency	Contributions were rambling and disorganized				Contributions were always to the point
Analytic sense	Seldom identified new issues or relevant major concerns				Frequently contributed very insightful comments

In the scale for Analytic Sense, the behavioral anchors for *Poor* and *Excellent* are not entirely parallel. A *Poor* rating is indicated in terms of identifying issues or concerns; while an *Excellent* rating is indicated in terms of making contributions.

Combining the anchors for *Poor* and *Excellent* results in a set of nouns, actions, and descriptors focused on identifying relevant features of a problem and contributing insightful comments to the group.

[7] This may appear as an unusual opposite pole to "never completed…" This scale focuses on how reliable a person is as a contributor to the team. All students have to agree to complete assignments; behavior for the low end of the scale is agreeing to complete assignments for the team, but not following through.

Table 26

Elements of Behavioral Anchors in the Analytic Sense Scale in the PBL Evaluation

Nouns	Actions or Operations	Descriptors
Issues Concerns Comments	Identify Contribute	New Relevant Major Insightful

The MCAT Verbal Reasoning Score as Additional Insight into Analytic Sense

A weak (R = .166) but significant (est. power = .78 at .05 sig. level) correlation between MCAT Verbal Reasoning scores and PBL Analytic Sense scores was found.

Table 27

MCAT Verbal Score * PBL Analytic Sense

		MCATV	MCATPhys	MCATBio
PBLAnalyticsense	Pearson Correlation	.166**	.115	.067
	Sig. (2-tailed)	.007	.062	.282
	N	262	262	262

The behavioral anchors for Analytic Sense and the skills and content of the MCAT Verbal Reasoning section suggest that the relationship could exist in the general population. Thus, the MCAT V will be added to the overall content analysis.

Table 28

Topics and Skills in the MCAT Verbal Reasoning Section

Content Topics Included	Skills Included
Humanities Social sciences Natural sciences	**Comprehension** of stated and unstated ideas **Evaluation** of arguments, conclusions, etc. Application to predict a result or solve a problem Incorporation of new information to re-evaluate ideas

An analysis of the correlated Clerkship behavioral anchors (in the following section) may provide contextual clues as to whether any elements from the MCAT Verbal skills are relevant to PBL Analytic Sense.

Behavioral Anchors for Family Medicine Clerkship Items of Interest

Clerkship behavioral anchors are indicated for five levels of each item. Verbs are and nouns are consistent throughout the levels, with the following pattern indicating level of performance:

1. Never
2. Inconsistently
3. Generally
4. Often
5. Consistently

Below are the anchors for knowledge. Of the four Clerkship variables of interest, this is the only item that focuses on knowledge. The others focus on skills.

Table 29

Behavioral Anchors for Knowledge Item in Family Medicine Clerkship Evaluation

	1	2	3	4	5
Knowledge in Subject Area: Includes level of knowledge and application to clinical problems.	Never demonstrates an understanding of basic principles. Never applies knowledge to specific patient conditions	Inconsistently Demonstrates understanding of basic principles. Inconsistently applies knowledge to specific patient conditions.	Generally demonstrates understanding of basic principles. Generally applies knowledge to specific patient conditions.	Often demonstrates understanding of basic and some complex principles. Often applies knowledge to specific patient conditions.	Consistently demonstrates understanding of basic and most complex principles. Consistently applies knowledge to specific patient conditions

Table 30

Structure of Behavioral Anchors for Clerkship Clinical Knowledge

	Leading Verb	Object Phrase
Element 1	Demonstrate	Understanding of basic principles
Element 2	Apply	knowledge to specific patient conditions

Ontological Map of all Factors and Items

On the following page is an ontological map, showing the content of each item in the context of correlated items. This map will be used to a) check for common themes that apply to all items, and b) consider how items correlated to Analytic Sense may provide insight into whether Analytic Sense is related to an unnamed factor.

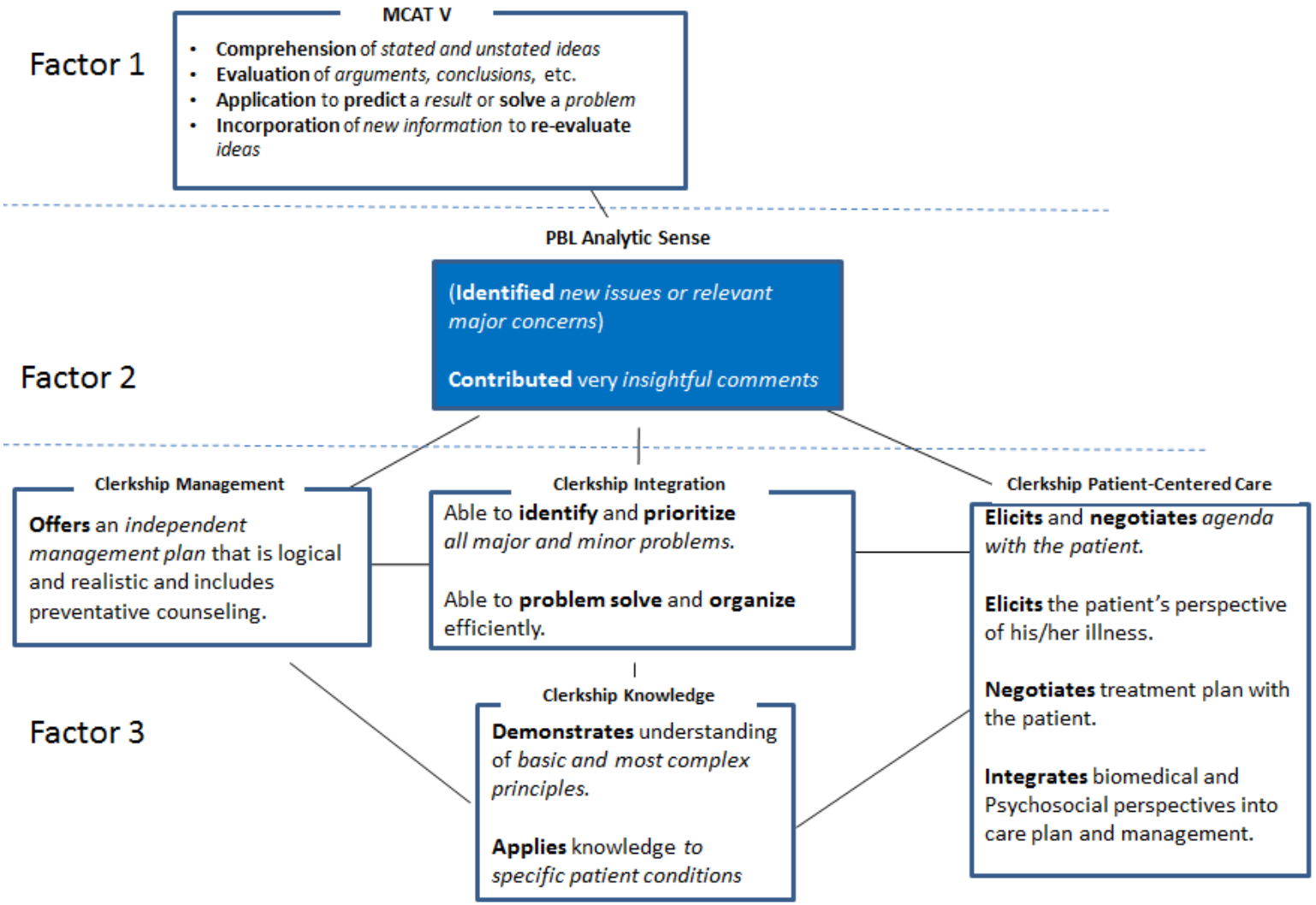
Analytic Sense emerged as the one item that was involved in more correlations than any other, by more than a factor of two. Therefore, it is the focus and center of the ontological map.

The map will be approached with this question:

What might Analytic Sense have in common with all other items in the map?

Interpretation of this map involves subjective evaluation. However, it is hoped that the two-dimensional linking of terms and phrases will make the subjective more visible and concrete, so that it can be analyzed and peer-reviewed with more objectivity.

Figure 6: Map of Verbs and Objects in Behavioral Anchors of Clerkship, PBL, and MCAT V Measures



Hypothesis: Problem-Finding

Regarding the question:

> *What might Analytic Sense have in common with all other items in the map?*

One probable hypothesis – the one that the author will argue is the most probable – is that the common element is *problem-finding*.

One of the defining characteristics of PBL is that problems are ill-structured, and students must work do define (find) the problem.

Ill-structured problems are complex problems that cannot be solved by a simple algorithm. Such problems do not necessarily have a single correct answer but require learners to consider alternatives and to provide a reasoned argument to support the solution that they generate (Hmelo-Silver & Barrows, 2006).

(Barrows, 2002) wrote that in PBL, "…problems are presented to the learner in the way they would present in the real world, as unresolved ill-structured problems, stimulating the generation of multiple hypotheses about cause and management. These problem simulations are designed to allow free inquiry by the learners to gather more information in their attempt to achieve understanding and resolution, while practicing and perfecting problem solving skills."

In a group setting, finding a problem requires agreeing on goals and priorities. These goals and priorities help determine what information is most significant and important. Goals and priorities must also be subject to change if new information provides a new perspective on the problem.

Table 31

Behavioral Anchors for Skills, and Possible Similarities with Problem-Finding

Item	Anchors	Similarities with Problem-Finding in a PBL Group Setting
PBL Analytic Sense	Identification of new issues or relevant major concerns. Contribution of insightful comments.	Identification and prioritization of important issues and concerns
Clerkship knowledge	Demonstrates understanding of basic and most complex principles. Applies knowledge to specific patient conditions	Recognition of what is abnormal, or does not fit an expected pattern of health Mental models of mechanisms of health and disease that guide prioritization
Clerkship Integration Skills	Problem-solving skills, ability to use data from patient interview, physical examination, and ancillary tests to identify major and minor patient problems in an organized and efficient manner. Identify and prioritize all major and minor problems. Problem-solve and organize efficiently.	Identification and prioritization of problems.
Clerkship Management	Offers an independent management plan that is logical and realistic and includes preventative counseling.	Framing of the problem to be managed Suggesting goals and priorities
Clerkship Patient-Centered Care	Elicits and negotiates agenda with the patient. Elicits the patient's perspective of his/her illness. Negotiates treatment plan with the patient. Integrates biomedical and psychosocial perspectives into care plan and management.	Eliciting and negotiating priorities and goals Integration of multiple frameworks

Problem Finding and Adaptive Transfer

Problem-finding requires adaptive transfer because there is no simple algorithm to accomplish or evaluate it. Problem-finding is rarely the same from case to case; it must be guided and built according to the needs of the situation and to the patient. Problem-finding must avoid the over-application of previously efficient schematized actions; otherwise new problems may be missed.

Chapter 5: Discussion of Findings

This chapter will discuss the results of the quantitative and qualitative studies in light of the evidence base from previous studies.

The Role of Knowledge in Overall Competence

The quantitative (factorial and correlational) study confirmed what many other studies about learning, knowledge, and skills have already found: knowledge is a factor in cognitive skills.

The importance of knowledge as a part of expertise and adaptive expertise is well documented and supported by evidence (J. D. Bransford & Schwartz, 2009a; Broudy, 1977; Eraut, 2004).

Examples of findings on the role of knowledge and skills include:

- Experts' knowledge cannot be reduced to sets of isolated facts or propositions but, instead, reflects contexts of applicability: that is, the knowledge is "conditionalized" on a set of circumstances.
- Experts are able to flexibly retrieve important aspects of their knowledge with little attentional effort.

  (Bransford, Brown, & Cocking, 2000, page 31)

The theoretical basis of PBL emphasizes the importance of students assessing constructing their own knowledgebase in the context of solving medical problems (Barrows, 1980b, 2002b; De Grave, Boshuizen, & Schmidt, 1996).

Regarding the role of knowledge in clinical competency, Geoffrey (Norman, 2005), in his review of research in clinical reasoning, concludes that "…experts use multiple knowledge representations in solving a problem, and the kind of knowledge brought to bear is more critical of success than the process" (p. 425).

Relationships between Behavioral Anchors

The present study found weak but significant relationships between behavioral anchors for verbal reasoning skills (MCAT V), analytic skills (PBL), and clinical skills (Clerkship).

Among the PBL * Clerkship item correlations, Analytic Sense stood out as the one PBL item that was correlated with more than any other Clerkship items. Its separation as a separate factor may have arisen only because Analytic Sense was measured in a separate context, approximately one year before.

Comparisons of the present study's relationships between those found in other studies are limited by differences in how different competencies are defined.

Agreement with the Medical Student Summative Evaluation (MSSE)

(Lee & Wimmers, 2011) conducted a factorial analysis of clerkship competence using three assessments:

- Preceptor's evaluations, using the Medical Student Summative Evaluation (MSSE) used by UCLA Medical School;
- Objective structured clinical examinations (OSCEs);
- National Board of Medical Examiners (NBME) subject examination.

The MSSE is a competency-based assessment that uses behavioral anchors, and addresses a range of topics similar to the UW Family Medicine Clerkship Evaluation. However, unlike the findings of this study, all items in the MSSE were found to be in one factor.

The following page shows a comparison of how Lee & Wimmers (2011) and the present study distributed different behavioral anchors into factors.

Table 32
Rotated Component Matrix for all Items that Evaluate Student Learning and Achievement

	Component			
	1	2	3	4
MCATV				.392
MCATPhys				.806
MCATBio				.814
PBLReliability		.727		
PBLEfficiency		.800		
PBLAnalyticsense		.754		
PBLDevelopingCKB		.669		
PBLInterpersonalrelationships		.733		
PBLEducationaAttitudes		.802		
PBLPersonalCharacteristics		.775		
ClerkshipKnowledgeofSubject	.728			
ClerkshipDataGatheringSkills	.706		.319	
ClerkshipClinicalReportingSkills	.726			
ClerkshipIntegrationSkills_A	.766			
ClerkshipManagementSkills_A	.776			
ClerkshipPatientCenteredCareSkills_A	.547		.418	
ClerkshipCommunicationSkills	.671		.367	
ClerkshipRelationshipswithPatients	.309		.733	
ClerkshipProfessionalRelationships_A			.712	
ClerkshipEducationalAttitudes	.461		.615	
ClerkshipDependabilityandResponsibility	.422		.653	

Figure 7: Factorial Analysis for three measures used in Lee and Wimmers (2011)

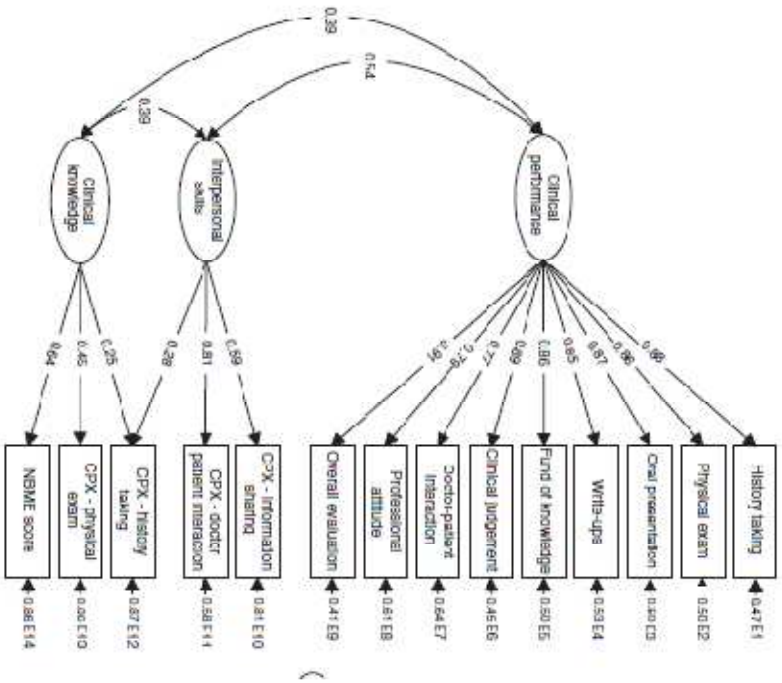


Table 33

Factors and Items in UCLA's MSSE Clerkship Evaluation Compared to UW PBL and Clerkship Items of Interest

UCLA MSSE Items		**Possibly Related UW Evaluation Items of interest**
Factor	**MSSE Scale**	
Clinical Performance	History Taking	PBL Analytic Sense
	Physical Examination	
	Oral Case Presentation	
	Write-Ups and Progress Notes	
	Fund of Knowledge	Clerkship Knowledge
	Clinical Judgment	PBL Analytic Sense Clerkship Integration
	Physician-Patient Interaction	Clerkship Patient-Centered Care Skills
	Professional Attitudes and Behaviors	
	Overall Rotation Performance	

A closer examination of the behavioral anchors for the MSSE (see following page) shows, however, that the items of interest in the two evaluation systems do not closely align. For instance, Physician-Patient Interaction on the MSSE is focused on physician to patient communication, while Patient-Centered Care in the UW Clerkship Evaluation is centered on establishing shared understanding and goals.

Table 34

MSSE Behavioral Anchors Compared with UW PBL/Clerkship Behavioral Anchors of Interest

UCLA MSSE Items		**Possibly Related UW Evaluation Items of interest**
MSSE Item	**MSSE Behavioral Anchors**	**UW Behavioral Anchors**
History Taking	• Precise, logical, thorough, reliable, purposeful, and focused. • Includes all pertinent positives and negatives.	PBL Analytic Sense Frequently contributed very insightful comments; ***identified new issues or relevant major concerns***
Fund of Knowledge	• ***Able to apply expected knowledge*** of disease, pathophysiology, and diagnosis. • Extensive, ***well-applied*** knowledge of disease, pathophysiology, diagnosis, and therapy. • Consistently up to date. • Almost always familiar with relevant current journal articles. • Able to search for information. • Judicious in selection of WWW materials.	Clerkship Knowledge Consistently demonstrates understanding of basic and most complex principles. Consistently applies knowledge to specific patient conditions

Clinical Judgment	• Able to ***determine priorities*** in the clinical data, weigh alternative diagnoses, risks and benefits of treatments, and suggest diagnostic procedures or therapies. • Regularly integrates medical facts and clinical data, weighs alternatives, costs, risks and benefits. • Understands limitations of knowledge. • Frequently applies evidence-based medicine.	PBL Analytic Sense (see above) Clerkship Integration Able to ***identify and prioritize*** all major and minor problems. Able to problem solve and organize efficiently.
Physician-Patient Interaction	• Communication is largely clear and jargon free. • Usually reflects empathic understanding.	

Selectivity, Analytic Sense, Adaptive Transfer, and Problem-Finding

As mentioned in Chapter 1, The College of Family Physicians of Canada commissioned a survey of physicians to develop a definition of competence in family medicine sufficient to guide a review of Certification examinations by the Board of Examiners (College of Family Physicians of CA, 2010).

Selectivity was identified as a competency that "…has not, to our knowledge, been previously described with respect to physician competence, although it is surely not an original idea." (p.4)

As noted earlier, selectivity shares many characteristics in common with adaptive transfer. It also shares many characteristics in common with the cluster of variables associated with PBL Analytic Sense and with problem-finding.

What follows is a table showing similarities between behavioral anchors for PBL and Clerkships, and problem-finding and selectivity.

Table 35

Behavioral Anchors for PBL and Clerkships, and Similarities with Problem-Finding and Selectivity

Item	Anchors	Similarities with Problem-Finding in a PBL Group Setting	Similarities with Selectivity (CFPC)
PBL Analytic Sense	**Identificatio**n of new issues or relevant major concerns. **Contribution** of insightful comments.	Identification and prioritization of important issues and concerns.	**Sets priorities and focuses** on the most important Knows when to say something and when not to
Clerkship Integration Skills	Ability to use data from patient interview, physical examination, and ancillary tests to **identify major and minor patient problems in an organized and efficient manner.** **Identify and prioritize** all major and minor problems. **Problem-solve and organize** efficiently.	Identification and prioritization of problems.	Determines the likelihoods, pertinence, and priorities in his or her differential diagnoses **Distinguishes** the emergent from the elective and intervenes in a timely fashion.
Clerkship Management	Offers an independent management plan that is logical and realistic and includes preventative counseling.	Suggesting priorities.	**Sets priorities and focuses** on the most important. **Distinguishes** the emergent from the elective and intervenes in a timely fashion.
Clerkship Patient-Centered Care	**Elicits and negotiates** agenda with the patient. **Elicits the patient's perspective** of his/her illness. **Negotiates treatment plan** with the patient. **Integrates** biomedical and psychosocial perspectives into care plan and management.	Eliciting and negotiating priorities and goals. Integration of multiple frameworks.	**Selects and modifies** a treatment to fit the particular needs of a patient and a situation. **Adaptable and selective** in approach, modifying it to suit both the situation and the patient.
Clerkship Knowledge of Subject	**Demonstrates** understanding of basic and most complex principles. **Applies** knowledge to specific patient conditions	Recognition of what is abnormal, or does not fit an expected pattern of health. Mental models of mechanisms of health and disease that guide prioritization.	Multiple representations allow modifying approaches to suit both the situation and the patient.

Confirmatory Evidence in Student Comments

Students had opportunities to comment on their experience in the PBL survey and in the follow-up survey. Comments from students who scored highly on PBL Analytical Sense and who also scored highly on their Clerkship Evaluations were reviewed.

Comments from students tended to be consistent with the behavioral anchors for the variables of interest. Positive comments tended to focus on:

- Opportunities to learn from other students;
- Opportunities to practice clinical reasoning skills (e.g., formulating a differential diagnosis);
- Opportunities to integrate knowledge from different subject domains.

In all but the Recommendations for improving question, positive comments outweighed negative ones by more than 10:1. Negative comments tended to focus on the use of time, and whether the time would be better spent studying alone rather than working in groups.

Recommendations for improvement tended to focus on the pacing, and covering more cases in the same amount of time.

Conclusion from Student Comments

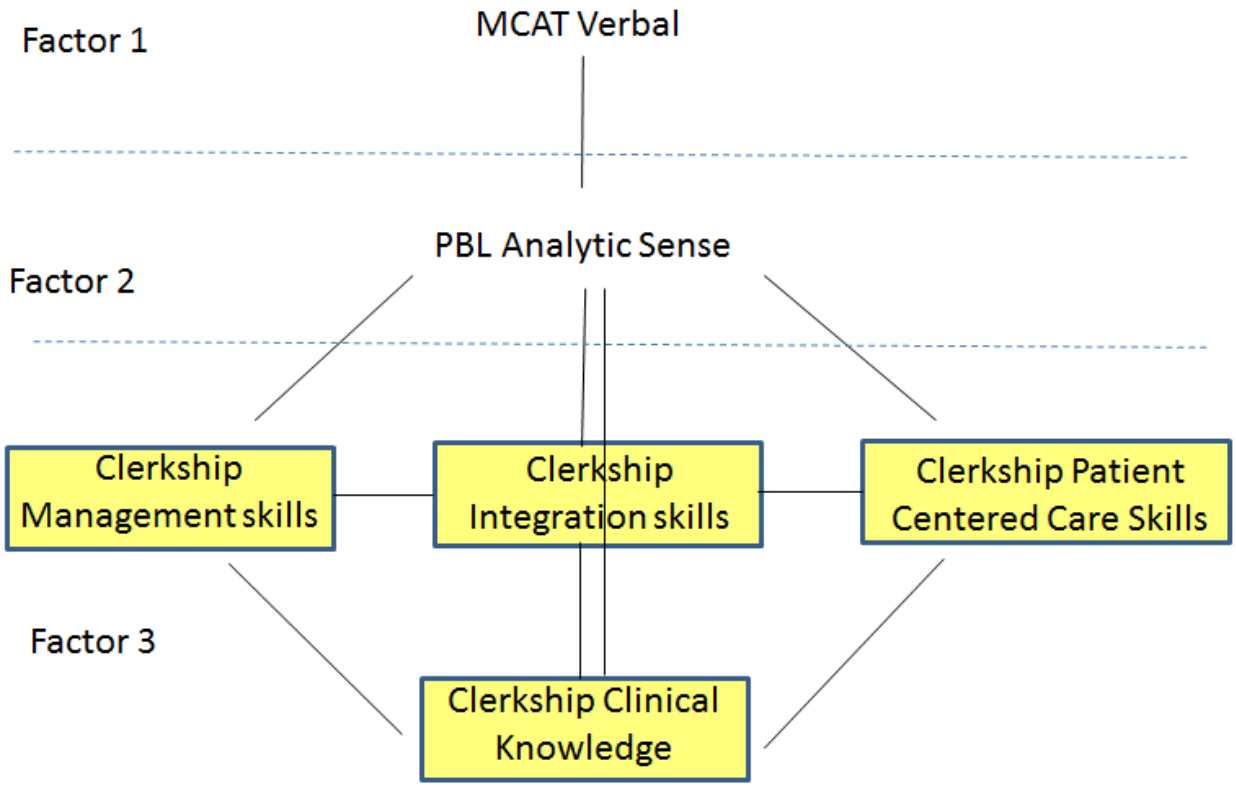
Student comments neither directly confirm nor directly contradict the finding that PBL Analytic Sense, Clerkship Integration Skills, Clerkship Management Skills, Clerkship Patient-Centered Care Skills, and Clerkship Knowledge share characteristics in common. More student comments, along with tutor and preceptor comments, are available and warrant further study.

Conclusion

This study attempted to define components of adaptive transfer in medical students by looking for factors and correlations in two contextual, qualitative assessments that use behavioral anchors.

Quantitative and qualitative analysis support the existence of the correlational and factorial relationships shown below. Evidence-based theory supports the existence of relationships between the measures shown below, and it supports the existence of a latent factor related to adaptive expertise or adaptive transfer. However, the evidence base does not confirm or contradict the exact structure of the correlations and factors found in this study.

While this hypothesis is *not* a complete picture of all of the factors related to physician competence (partly because the number of variables was intentionally limited in this study), it may indicate a new finding in understanding and defining adaptive transfer in terms of commonalities between related factors and behavioral anchors.



Problem-Finding and Adaptive Transfer

The study found that the item Analytic Sense, which is the one PBL Evaluation item correlated with the largest number of Clerkship Evaluation items, shares characteristics in common with:

- Problem-Finding in PBL (Hmelo-Silver, 2004b; Barrows, 1986);
- Adaptive Transfer (D. Schwartz et al., 2012);
- Selectivity (T. Allen et al., 2011).

This overlap may represent a distinct characteristic and factor in adaptive transfer in medical students. It appears to be related to these mental operations and behaviors related to problem-finding:

- Understanding the significance and meaning of information within a broader context;
- Determining the nature of a problem;
- Negotiating shared goals and priorities in a group;
- Selectively attending to new information that is significant to a problem.

Further Research

Many fields in health sciences recognize the need for competency-based training and evaluation systems. Competencies that emphasize flexible use of knowledge and skills can be used as operational definitions for components of adaptive transfer.

More work is needed to better define and validate competencies and behavioral anchors. This work must involve studies of experts at work, as well as longitudinal studies to see how competency-based education, training, and feedback contribute to improvement in practice and outcomes.

The present study was done with a non-random sample, which introduces the risk of bias in the sample and limits the statistical power of the findings. If possible, the study should be replicated using data from more cohorts and more subjects within each cohort, to see if the relationships and factors still appear.

Data used for this study include comments from students, tutors, and preceptors. These data could be analyzed and compared with the quantitative analysis.

The process of finding and solving problems within a group context has been studied for decades. However, like learning itself, problem-finding is a complex process that warrants much more research to understand the factors involved. Of particular interest is the process of problem-finding in interdisciplinary teams, where different members have different areas of expertise.

The present study focused on cognitive aspects of the clinical decision-making process. Some of the most significant (and potentially most important) benefits of PBL are in the affective and social domains. PBL has already been shown to contribute to positive attitudes toward lifelong learning. More research needs to be done on the effects of PBL on patient-centered care, team behavior, stress and mental health on/of caregivers, and turnover in medical care.

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Appendix A: Glossary

Term	Definition
Adaptive Expertise	Procedural fluency that is complemented by an explicit conceptual understanding and sense of personal identity that permits adaptation to variability, while avoiding the over-application of previously efficient schematized actions that worked in the past but need modification when new issues arise (Hatano & Oura, 2003) as quoted in Lin et al., 2007, p. 3).
Adaptive Transfer	Transfer of newly-learned knowledge in an adaptive fashion; transfer that avoids over-application and permits adaptation to variability.
Behavioral anchor (for competencies)	Observable, describable behaviors determined to be valid indicators of a particular competency.
Competency	A measurable pattern of knowledge, skills, abilities, behaviors, and other characteristics that an individual needs to perform work roles or occupational functions successfully (U.S. Office of Personnel Management, retrieved 11/2013).
Transfer	The ability to extend what has been learned in one context to new contexts (Bransford et al., 2000, p. 51, citing Byrnes, 1996, p. 74).

Appendix B: Student Account of Taking the MCAT Exam

(Retrieved from https://www.aamc.org/students/aspiring/basics/280602/mcat-take.html on 11/29/2013)

What's it Like to... Take the MCAT® Exam?

Colleen Kays
Hometown: Gainesville, FL
Medical School: Columbia University College of Physicians and Surgeons, Class of 2013

What was the testing site like? How many people were in the room?

The testing site is set up in a highly regulated manner. There's a lobby with lockers and there's a room with computers. Each computer is partitioned off from the others. Although there may be up to 20 or 30 other people in the room, it's completely silent and the partitions make you feel like you're there by yourself.

To get into the computer room where you will take your test, you have to sign in, have your fingerprint scanned, show your picture ID, and prove that you have nothing else on you (other than earplugs if you choose). Every time you leave the computer room, you have to sign out and scan out with your fingerprint again.

What can you have with you?

Not much! When you enter the test room, you'll have to bring your picture ID (current government-issued ID, with an expiration date, your photo, and your signature; your driver's license or passport will work). You can bring earplugs in with you too, which is a good idea even if you don't think you'll use them, just in case. Beyond that, you can't bring anything else in with you.

You **cannot** bring any food or drink; that stays in your locker and you can get it out during breaks. You also **cannot** bring pencil or paper, but the test site will provide you with something to write on. At my center we were given booklets of paper and two pencils; if we filled up the booklet we could ask for a new one, but they would take away the used one at the same time. Some centers use laminated paper and dry erase markers instead.

You **can** bring a jacket into the test room with you, and wearing layers is a good idea! Some test sites are freezing, but I also have a friend who took her MCAT exam at a site where the A/C was broken…in July. (She survived and is a medical student now!) You'll feel more comfortable if you're prepared for any testing situation.

How was taking the test on a computer?

Not bad at all! When you're studying, make sure to spend some time doing at least one practice test on your computer at home to make sure that you're used to it. You'll also want to explore in advance how to use the functions on the test, such as highlighting information, crossing out answers, and marking questions. There's a tutorial at the beginning that goes over how to use all of those features as well. Overall, I think it's actually more comfortable taking the test on a computer than taking it as a written exam, where your hand starts to cramp up from filling in so many bubbles.

How long did it take? Did you get breaks?

All morning (or afternoon)! It's surprising how exhausting it is to be thinking so hard for so long. The test is five and a half hours long, and the breaks are important to help you refresh! You're not allowed to leave the test room while you're in the middle of any section, but in between each of the 4 sections there's a 10-minute break. You have to make sure to time the break yourself; your next section will start if you're gone for more than the allotted 10 minutes. But during that time, you can leave and use the restroom and have a snack. You're not allowed to study or use your phone during that time.

Did you finish each section?

I did finish each section, but I also practiced a lot in advance by using the materials available on the AAMC Web site.

How long until you got your scores?

About a month. Your score will be put online when it's available, but don't start checking for it after just one week! It really does take about 4 weeks.

Do you have any advice?

Take your studying seriously, but don't overwork yourself! You'll definitely want to give yourself time to prepare, by studying the material and doing practice exams, but you can certainly still be working or in school during that time. Try to pick a lighter course schedule, though, if you can.

Appendix C: Problem-Based Learning at the UW School of Medicine

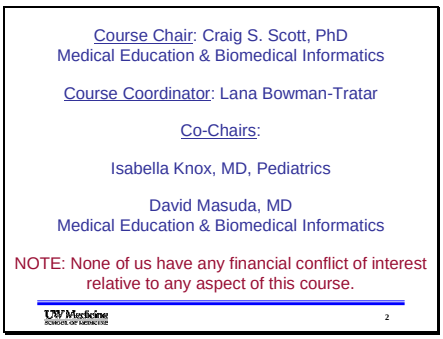
Part 1: Student Orientation to PBL

From the 1980s through 2010, the UW School of Medicine required that all MD and Physician Assistant (PA) program students take a one-quarter PBL course that integrated multiple disciplines within healthcare (e.g., Family Medicine, Psychiatry, Cardiology, and Oncology).

What follows is a presentation given to students to explain the program and how to be successful PBL students.

Slide 1

Slide 2



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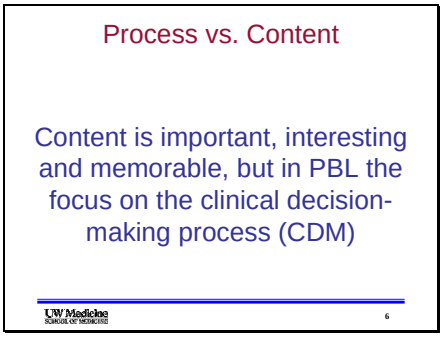

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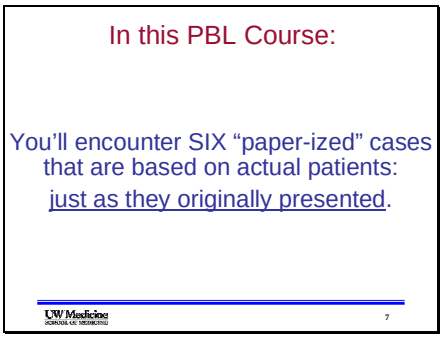


Slide 8

Realistic, "Ill-defined" Cases

- ✓Nothing is made up.
- ✓There will be "noise"
- ✓Important information will be missing.
- ✓Some information will be ambiguous.
- ✓Just like real patients!

UW Medicine SCHOOL OF MEDICINE 8

Slide 9

Each of the 30 PBL Groups will have:

7 to 9 medical students and 0 or 2 PA students

UW Medicine SCHOOL OF MEDICINE 9

Slide 10

The UWSoM PBL Process: 3 sessions (4 hours) per case

- ➢Session I: Day 1 material > ID Objectives
  - ✉*1 hour* *Independent study*
- ➢Session II: Information sharing
  Day 2 material > ID Objectives
  - ✉*2 hours* *Independent study*
- ➢Session III: Information sharing > Debriefing
  Finish the case, begin next case
  - ✉*1 hour + a 2nd hour to begin the next case*

UW Medicine SCHOOL OF MEDICINE 10

Three sessions per case

Slide 11

Each case begins with a
"Clinic" Note

UW Medicine SCHOOL OF MEDICINE 11

Slide 12

Day 1 material is passed out.
Then someone volunteers to read aloud each "Day's" material :
Hx, PE, Labs

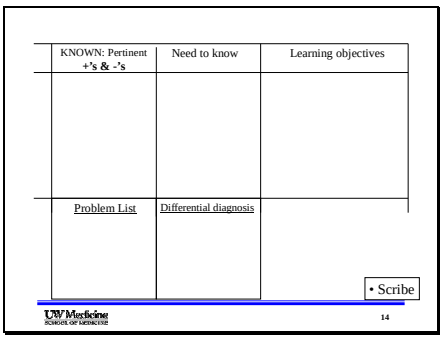
UW Medicine SCHOOL OF MEDICINE 12

Slide 13

A student "scribe" writes main points of the discussion

UW Medicine SCHOOL OF MEDICINE 13

Slide 14



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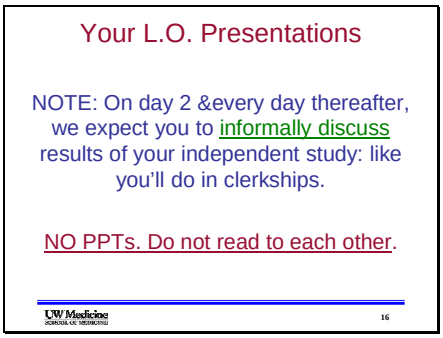
Slide 16



Slide 17

On "Day 2" of Each Case

- Everyone talks INFORMALLY about what they found out about the learning objective for which they took responsibility at the end of the previous session.
- Be sure to discuss how your information does or doesn't apply to the case.

UW Medicine SCHOOL OF MEDICINE 17

Slide 18

Day 3 Post-Case Debriefings

- How well was this case handled by the provider? What was done well? What could have been done better?
- How well was this case handled by group? Did the experience arouse any emotions in you that you'd like to discuss?
- Any clinical insights?
- If we (our group) could begin this pt again, what might we do differently?

UW Medicine SCHOOL OF MEDICINE 18

Slide 19

Summary of Student Roles

1) Scribe (every session)

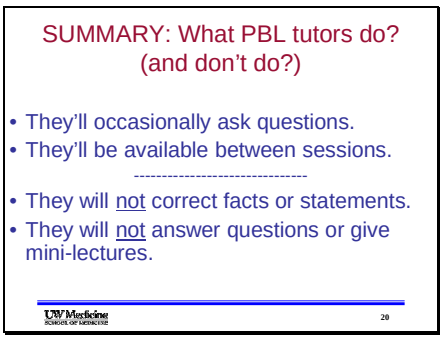
2) Recorder (permanent or rotating?)

(electronic template)

3) Debriefing Host (only on day 3)

UW Medicine SCHOOL OF MEDICINE 19

Slide 20



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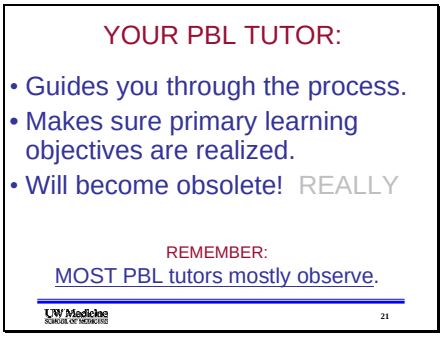

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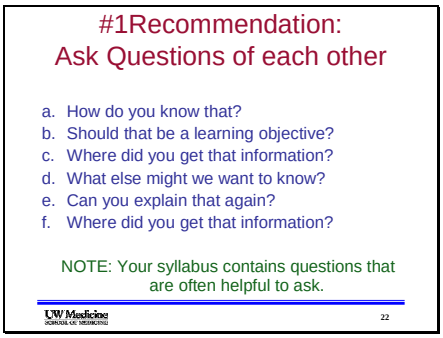

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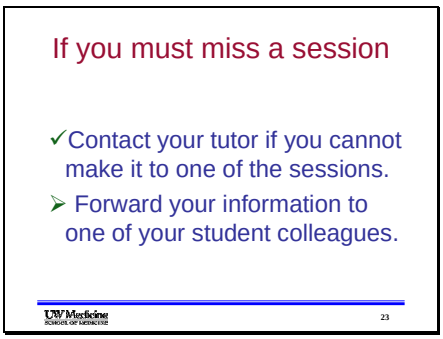

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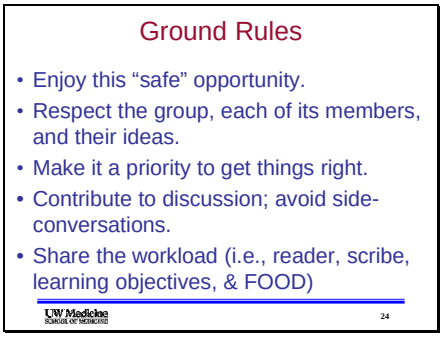

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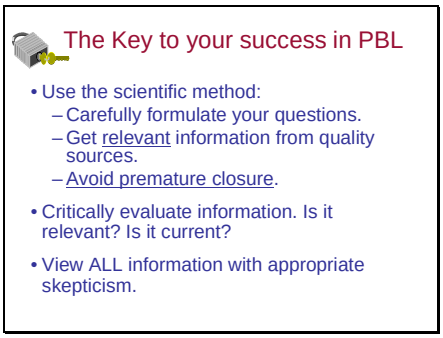


Slide 26

Part 2: Tutor Orientation to PBL

What follows is a presentation given to tutors to explain the program and how to be successful PBL tutors.

Slide 1

PBL Tutor Orientation for NEW Faculty:
Practical Considerations

Craig S. Scott, PhD, Professor
Biomedical Informatics & Medical Education
scottcs@u.washington.edu
Cell: 425.466.6535
April, 2013

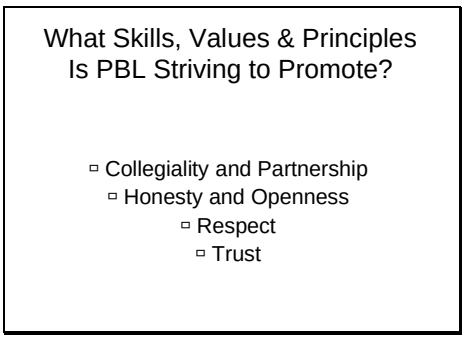
I've been asked to talk about Problem-Based Learning.
While I frequently do that, I usually take considerably more than 15 minutes.

Slide 2

Preview

How learning in PBL is different.
The unique Tutor/Student Roles
The structure of the PBL cases
The process

Slide 3



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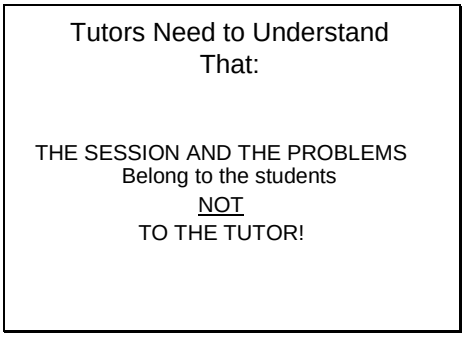

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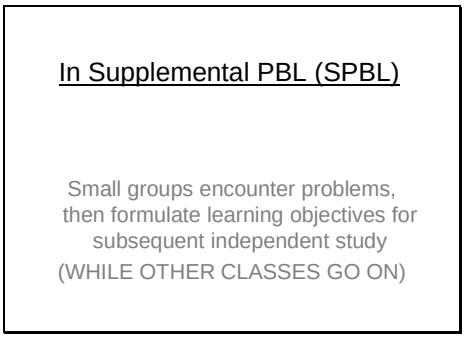


Hol Hog: Too much of a different thing

not a panacea

Slide 6

PBL Should Help Provide Students With Needed Keys to the Future

- Use the scientific method to:
  - Ask the right questions.
  - Set their learning objectives.
  - Get relevant, quality information.
  - Avoid premature closure.
- Groups need to view all information with appropriate skepticism.

Slide 7

PBL = Problem Based Learning.

CBL = Case based Learning.
They are NOT the same!

The focus is on the PROCESS; Content is nice but incidental.

Slide 8

The Skills we want to foster in PBL

Evaluating & Prioritizing information.

Assessing the condition of the patient.

Knowing when not enough is known to proceed.

Locating clinical evidence and guidelines.

Critically analyzing information interpreting it appropriately.

Slide 9

The idea with PBL is to "MIMIC" Real Life with the written case material:

To "MIMIC"

I've been asked to talk about Problem-Based Learning.
While I frequently do that, I usually take considerably more than 15 minutes.

Slide 10

At the UW School of Medicine "Supplemental" PBL (SPBL) is:

- MULTIDISCIPLINARY
- Problems are semi-coordinated with lectures.
- 30 concurrent groups of 8-9 students are challenged by problems like those they WILL encounter as professionals.

Slide 11

UWSoM PBL Cases Are:

- Based on real patient cases. Students should know that they are not artificial.
- Provide safe opportunities for students to practice on real problems.

■Instruction does not necessarily result in learning.

Slide 12

KEY CONCEPT:
[That Case Developers and Tutors Must Understand]

By Design
PBL Problems are
"ILL Structured"

meaning ("Poorly Structured")

Slide 13

CHARACTERISTICS OF PBL's
"ILL STRUCTURED" PROBLEMS

(as opposed to the well structured problems that are usually used in small groups)

More information is available than will be needed in order to solve the problem.

As information is obtained, the problem WILL change.

Slide 14

WITH "ILL STRUCTURED" PROBLEMS STUDENTS COME TO REALIZE THAT:

Important data may (will) be lacking.
Some INFORMATION will be contradictory/ambiguous.

BUT, DECISIONS STILL NEED TO BE MADE; JUST LIKE IN THE REAL WORLD!

Slide 15

The Skill of the SPBL Tutor/Facilitator Is Critical

The tutor's role is to facilitate the process; to be sure all that students are working on the above skills.

Three sessions per case

Slide 16

The UW's SPBL Process: In 2012, 3 sessions (4 hours) per problem

- Session I: Day 1 written information
  Group discussion - ID Day 1 Learning Objectives
  [1 hour]
  - ***Break: Independent study***
- Session II: Information sharing followed by Day 2 information & discussion - ID Day 2 Learning Objectives
  [2 hours]
  - ***Break: Independent study***
- Session III: Information sharing followed by Day 3 information & DEBRIEFING - Problem wrap-up
  [1 hour]

Three sessions per case

Slide 17

ADD DEBRIEFING SLIDE that includes "Did the experience arouse any emotions in you that you'd like to discuss?

- Session I:

Three sessions per case

Slide 18

The Multidisciplinary SPBL Cycle

Day 1:	Case 1, Day 1	(1 hour)
Day 2:	Case 1, Day 2	(2 hours)
Day 3:	Case 1, Day 3; Case 2, Day 1	(2 hours)
Day 4:	Case 2, Day 2	(2 hours)
Day 5:	Case 2, Day 3; Case 3, Day 1	(2 hours)
Day 6:	Case 3, Day 2	(2 hours)
Day 7:	Case 3, Day 3; Case 4, Day 1	(2 hours)
Day 8:	Case 4, Day 2	(2 hours)
Day 9:	Case 4, Day 3; Case 5, Day 1	(2 hours)

Slide 19

30 Concurrent Small Groups of 9 to 10 Students Direct Themselves:

- Conceptualize the problem.
- Determine what's: KNOWN, UNKNOWN & WHAT THEY NEED TO KNOW
- Identify learning objectives.
- Find answers for their learning objectives.
- Report to the group what they've learned.
- 3-COLUMN Format.

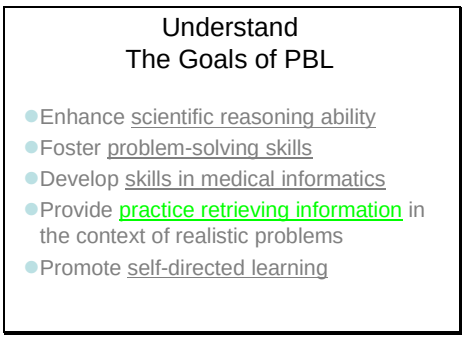
Slide 20

ABOVE ALL: Tutors Must Understand that PBL is in the Curriculum.

To provide students practice with clinical decision-making.

The focus is on process and outcomes (content is incidental)

Slide 21



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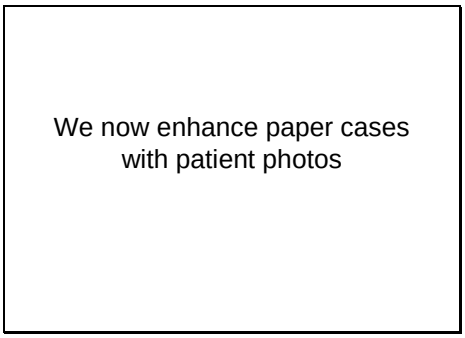
Slide 23



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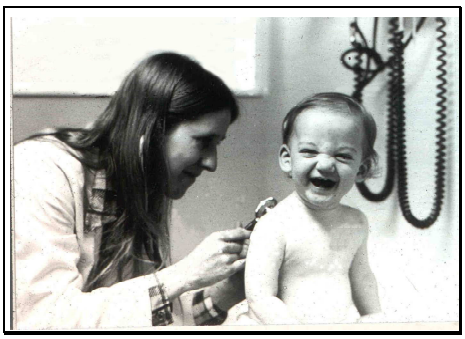


Slide 25

We now working on enhancing cases with videos of patients

Slide 26

PREVIEW of SPBL's MULTIDISCIPLINARY CASES

PBL Tutor (Facilitator's) Guide
And
Sample Case

Slide 27

SEE PAGE 53

Slide 28

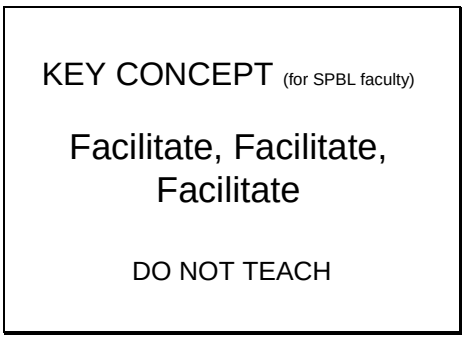
Consider supplying students with clinical forms and information: like they will be using in the hospital or clinic.

See page 41

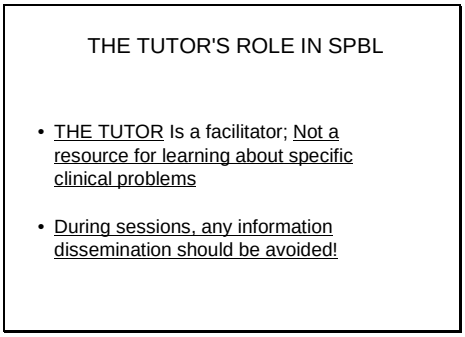
Slide 29

The Role of the Tutor

Slide 30

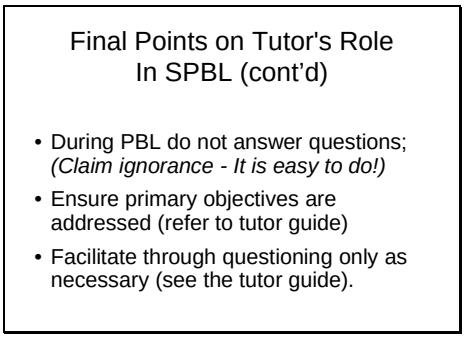


Slide 31



Three sessions per case

Slide 32



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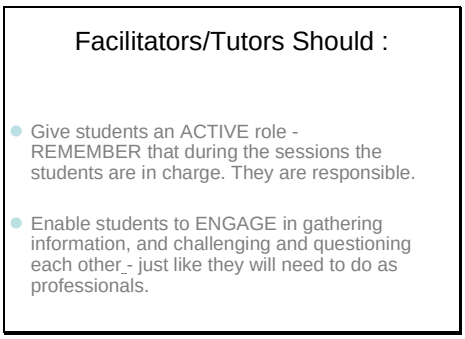
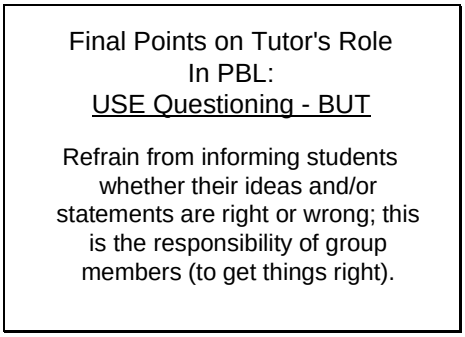


Allow them to fail
Allow incomplete information
Allow incorrect information.
Allow misinterpretations.

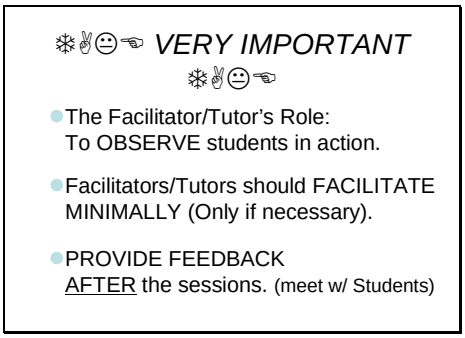
It is their responsibility to correct the process and the information

Slide 34



Three sessions per case

Slide 35



Slide 36

Expectations of Faculty PBL Tutors

Slide 37

Getting students to participate. It can be a challenge!

- Consider conducting several training sessions for both tutors & for students (Make expectations clear).
- During Orientations, Show videos of SPBL groups in action.
- Use periods of "SILENCE" - Silence is your friend - silence makes humans uncomfortable.

Slide 38

Evaluation of Students

Slide 39

EXAMPLE
PBL Student Evaluation

University of Washington
School of Medicine

Slide 40

1. Rate student's PROBLEM SOLVING SKILLS:

Reliability:

Poor	Fair	Good	Very Good	Excellent
Never completes assignments as agreed to				Always willing to assist others when appropriate

Efficiency:

Poor	Fair	Good	Very Good	Excellent
Contributions were rambling, disorganized				Contributions were always to the point

Analytic Sense

Poor	Fair	Good	Very Good	Excellent
Seldom identified new issues				Frequently contributed insightful comments

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2. Rate Student's CLINICAL KNOWLEDGE BASE:

Data Skills

Unsatisfactory. Needs work on acquiring, recording & analyzing	Has basic data. Needs work on organization	Data complete. Satisfactory organization	Data assessment Outstanding.

3. How do you rate this student's INTERPERSONAL RELATIONSHIPS:

Often discourteous	Fair rapport	Generally good rapport	Consistently courteous

4. How do you rate this student's EDUCATIONAL ATTITUDES:

Often argumentative. Reacted poorly to criticism	Responded to questions. Did not volunteer. Rarely contributed	Good participation. Accepted criticism. Eager to learn	Excellent participation

5. How do you rate this students PERSONAL CHARACTERISTICS:

Not motivated. Appeared disinterested	Accepted average work load	Did all work expected	Exceptionally dedicated

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SEE PAGE 31

Slide 43

In Summary

- PBL was developed as a reform movement in medical education in the late 1960's
- There is no 1 "right way" to do PBL- factors such as # of students, faculty and resources available need to be considered
- PBL evaluation is both "process" and "outcome-oriented"
- Consider developing a variety of PBL-like activities

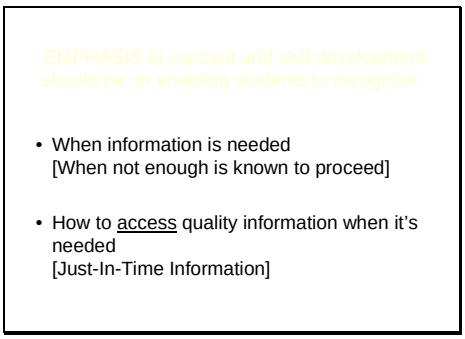
Slide 44

General Principles for Thinking About Information and PBL

- Use of technology should be driven by educational need [NOT availability]
- Faculty and students need clear statements of what informatics competencies are expected by graduation.

"Assumed "At Entry"
>>> To be "Attained Early" and
>>> To be "Demonstrated by Graduation"

Slide 45



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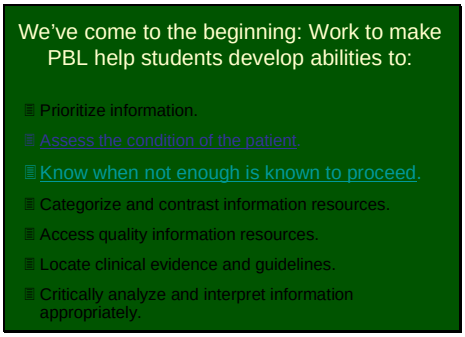

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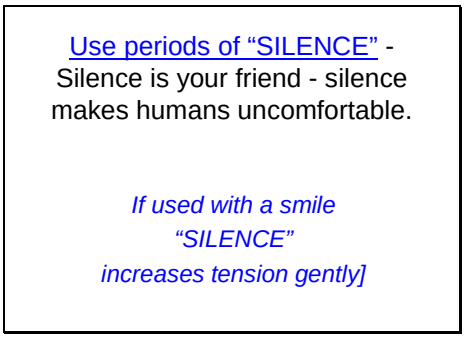

This expectation must be communicated to students.

The "silence" technique should be kept secret.

Slide 48

The Daily Packets

15-45 minutes before the sessions:
Pick up packets in E-312

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Appendix D: Syllabus for Family Medicine Clerkships at the UW School of Medicine

The following information was retrieved from the UW Family Medicine Program website (http://depts.washington.edu/fammed/education/courses/clerkship) in October, 2013.

WELCOME TO THE FAMILY MEDICINE CLERKSHIP

On behalf of our faculty across the WWAMI region, we would like to welcome you to your clerkship experience. We hope that you will find your clerkship to be intellectually challenging and rewarding. You will spend six weeks working side by side with family physicians and family medicine residents caring for patients. Our teachers work hard to provide you with an excellent learning experience, and we appreciate and welcome feedback. If you have questions or concerns about your clerkship, please feel free to contact us at (206) 543-9425.

Best wishes for a successful clerkship experience,

Misbah Keen, MD, MPH, MBI

Clerkship Director mkeen@uw.edu (206) 543-9425

Jeanne Cawse-Lucas, MD Associate Clerkship Director cawselucas@fammed.washington.edu (206) 543-9425

Lisa Le, BA Clerkship Coordinator

fmclerk@fammed.washington.edu

(206) 543-9425

(Updated August 2013)

University of Washington Family Medicine Clerkship

FACULTY AND STAFF:

Clerkship Director - Misbah Keen, MD, MBI, MPH

The Clerkship director is responsible for overseeing the curriculum, grading and faculty development.

Associate Clerkship Director – Jeanne Cawse-Lucas, MD

The Associate Clerkship director works closely with the Clerkship Director overseeing the curriculum, grading and faculty development.

Clerkship Coordinator – Lisa Le, BA

The Clerkship Coordinator is the day-to-day contact for the Seattle clerkship office. The Clerkship Coordinator will contact you about your site, send you reminders during the clerkship and can answer general questions about the clerkship.

Site Director

The Site Director, who may also be referred to as "Faculty Coordinator" or "Primary Preceptor", is your central contact person during your rotation and the individual who will perform mid and end of clerkship evaluations. While most sites have a single Site Director, a few sites have Co-Directors.

Site Coordinator

Site Coordinators provide primary administrative support for the clerkship at the site including organizing important paperwork, creating student clinical schedules, acting as a central contact for the site and assisting students with any administrative issues during the clerkship. It is important to contact this person several weeks before your clerkship, allowing ample time to complete necessary site paperwork, so you may begin your clerkship on time. Not every site has a designated Site Coordinator in which case the Site Director will guide you through administrative tasks.

PREPARATION AND ORIENTATION

Below is a list of what you should do before arriving at your clerkship site and what to expect from your orientation when you arrive.

Four to Five Weeks Before

- Review the detailed site description, site requirements and transportation requirements that will be emailed to you by the Clerkship Coordinator.

Two to Three Weeks Before

- Contact your Site Director and/or Site Coordinator and send him/her the Student Summary Sheet.
- If relevant to your rotation, confirm with the Site Director or Site Coordinator where to get keys for your apartment and where to go on your first day of the clerkship.
- Ask your Site Coordinator about any site-specific paperwork you may need to fill out prior to your clerkship. Completion of this paperwork is vital to ensure you have access to all administrative programs on the first day of your clerkship.
- Familiarize yourself with the clerkship syllabus. Pay close attention to the four curricular areas, your required tasks, the readings links and the evaluation policies. If you have questions about this information, please contact the Clerkship Coordinator or Clerkship Director at (206) 543-9425.

One Week Before

- Review absence policy and duty hours.
- Mark your final exam day on your calendar. This is on the last Thursday of the rotation (10:00 AM to 12:30 PM Pacific Time).
- Register for FmCases, SIMPLE and CLIPP Cases at this website using your UW email address:
  http://www.med-u.org/register/
- Prepare for lodging / travel and specifics including transportation and appropriate weather and clinical attire. Contact your site if you have questions.
- Visit and bookmark the Family Medicine Clerkships "Info for Students" webpage here:
  http://depts.washington.edu/fammed/education/courses/clerkship/info
- From there, click on the "Clerkship Assignment Tracker" link and log on to the Assignment Tracker, where you should take time to familiarize yourself with the weekly requirements of the Clerkship.

First Week Orientation

Your clerkship orientation will be completed at your clinical site. You will need to participate in a required Webinar from **12 to 1PM PST** on the first day of your rotation. This webinar will review the clerkship website, policies, goals, objectives and requirements for successful completion. You should receive login information about this webinar from the clerkship coordinator roughly a week before the webinar.

You should also expect to receive the following at your site-specific orientation:

- A schedule for your clerkship, including call duties
- Key contact information for site faculty and staff
- A safety briefing and a tour of the clinical facilities
- Passwords for electronic medical record systems and any needed orientation to the system
- A meeting with your primary preceptor to discuss your duties

GOALS AND OBJECTIVES

Our goal is for you to learn and apply the **key components of the Family Medicine approach to health care** during your clerkship:

1. *Biopsychosocial Aspects of Care*
   Family Physicians gain insight into psychological, social and cultural factors that affect health through eliciting and understanding the patient's perspective on their illness.

2. *Comprehensive Care*
   Family Physicians care for all of a patient's needs, including acute care, chronic illness care and preventive care. This care spans the lifetime of the patient and acknowledges the role family plays in the care of the individual.

3. *Continuity of Care*
   Family Physicians provide care over the lifetime of a patient. The care plan can be augmented by consultants and other healthcare professionals, but the Family Physician takes primary responsibility for the health and well-being of the patient.

4. *Context of Care*
   Family Physicians develop treatment plans collaboratively with patients and families that are evidence-based, safe and produce high quality outcomes that enhance functional status and quality of life in a culturally responsive manner.

5. *Coordination and Integration of Care*
   Family Physicians are the managers of the patient's overall healthcare plan. The Family Physician collaborates with specialists and other healthcare professionals in disease management, health promotion and patient education.

Four Primary Objectives:

a. Learn and apply **knowledge of common problems, wellness and prevention** within the framework of the Family Medicine approach to patient
   care.

b. Learn and apply **effective patient-centered care skills**, including discussing health behaviors with patients and using a patient-centered approach to the electronic health record.

c. ***Learn about*** *principles of family medicine and critical role of family physicians in modern healthcare systems.*

d. **Act professionally** in the care of patients, care of families and in interactions with your health care team and communities.

OVERVIEW AND ASSIGNMENTS

Curriculum Overview

The clerkship curriculum focuses on four core areas. The Family Medicine Assignment Tracker outlines the weekly requirements with respect to these core areas and will help you fulfill the requirements of the clerkship.

1. *Clinical Knowledge and Skills*

   During your clerkship, we anticipate that you will have contact with patients with many common problems. These problems are listed on the Family Medicine Assignment Tracker, and you should review the Common Conditions list within the Tracker. As you see patients with these conditions, track your interactions with them. We also provide access to FmCases (Interactive modules featuring common family medicine cases), SIMPLE (internal medicine cases) and CLIPP (pediatric cases). The Tracker indicates cases related to each common problem. You are not explicitly required to complete all these cases; however, the final exam is entirely based on the online modules.

2. *Effective Patient Centered Care (EPCC)*

   Effective patient-centered care translates the art of medicine into defined and learnable skills. These skills include exploring the patient's needs and beliefs, counseling patients about health behaviors, incorporating the electronic health record into the visit and co-creating a plan. Follow the week-by-week plan in the Assignment Tracker to develop your skills in this area.

3. *Other Curricula*

   A) Articulating and Reflecting Tacit Expertise (ARTE)

   The goal of the ARTE program is to increase your understanding of the process and content of a family physician's thinking while increasing your capacity for reflection (mindfulness) along side your preceptors. The ARTE program consists of a series of online modules accessible through the Assignment Tracker.

   B) *Principles of Family Medicine*

   C) Critical Role of Family Physicians within modern healthcare systems

   Both of these curricula consist of online modules accessible through the Assignment Tracker

4. *Professionalism*

   Professional behavior is a skill that students and faculty will develop and refine throughout their careers. Using the expectations listed on our website, students should reflect on their skills and attitudes and seek help when appropriate.

Administrative Activities

You are required to complete a set of administrative activities to guarantee satisfactory progress in your clerkship.

1. *Update Your Assignment Tracker at the End of Every Week*
Failure to update the form every week, including Week Six, will have an impact on your grade. Any missing requirements will result in a make-up assignment to be determined by the Seattle clerkship office. Be sure to document your encounters with Common Conditions.

2. **Participate in the Orientation Webinar. (First Monday 12 to 1PM PST)** Students are expected to participate in an online webinar orientation on the first Monday of the clerkship rotation from 12 to 1PM Pacific Time. Holiday schedule may change the time / day of the Webinar and you should receive an email from the clerkship coordinator with login details and exact time / date, roughly a week before the webinar.

3. **Participate in Clinical Reasoning Webinar. (Third Monday 12 to 1PM PST)** During this webinar we will go over 14 multiple choice questions taken from FmCases. The questions are identical in format to the final exam and will be based on four FmCases: Case 2 (Adult Prevention), Case 4 (Ankle Sprain and UTI), Case 6 (Diabetes), and Case 21 (Flu, Pneumonia, Pediatric Obesity). This webinar is hosted by the Seattle Clerkship Team and UWSOM Academic Skills Counselor, Jamey Cheek. Holiday schedule may change the time / day of the Webinar and you should receive an email from the clerkship coordinator with login details and exact time / date, roughly a week before the webinar.

4. *Schedule and Actively Engage in Mid/End of Clerkship Reviews*
The purpose of these reviews is to provide you with summative and formative feedback on your performance and track your completion of the clerkship curriculum. Reviews are held with your Primary Preceptor or the Site Director.

Be sure to print out two copies of your assignment tracker to bring to each review session.

Your Mid Clerkship Review should be held during the third week of the clerkship. Your End of Clerkship Review should be done in the sixth week of the clerkship. In both review meetings, your Site Director will share feedback about your performance in the rotation. Feedback may include things you did well and things that you should focus on during your next rotation. You are encouraged to ask questions during these meetings if it is unclear or if you need further guidance about improving your performance.

UW Family Medicine Clerkship
FINAL EXAM Instructions

This exam will test your application of the clinical knowledge you have gained from the clerkship, as well as from the recommended Cases (33 FmCases and seven SIMPLE and CLIPP cases).

The examination is administered on Thursday of week six of the clerkship from 10:00AM to 12:30PM Pacific Time. You will be emailed the link for the exam by the Monday prior to the exam.

1. You will need to make arrangements with your lead faculty member to take the exam at the site using a site computer (usually the same computer you used for the practice exam). You will not be permitted to use your personal computer for the exam.

2. You are given 2.5 hours to complete 90 questions.

3. The exam is based exclusively on the 33 FmCases and seven SIMPLE and CLIPP cases delineated in the Assignment Tracker.

4. The exam is closed book. You may not use materials or ask anyone for help answering the questions during the exam.

5. The exam is based on an honor system. The honor system is considered violated when information which results in or could result in an unfair advantage for one or more students is given or received before, during or after a test. Students who violate the honor system are subject to failing the exam and/or clerkship.

6. You will be permitted to submit your exam only once and all submissions are considered final.

7. You will receive immediate feedback on total score and also how you scored in the following categories:
- Diagnosis / Evaluation
- Mechanisms of Diseases
- Management / Therapeutics
- Health Maintenance

8. Student final exam scores will count as one of the twelve scoring categories on the final evaluation. The Seattle Clerkship Office will assign this score after the rotation has been completed.

For the 2013-2014 school year, the final exam scores will be interpreted as follows: 5 score (80 percent and above)

4 Score (74 percent and above)

3 Score (Depending on the question set used, is between 58 and 62 percent and above)*

2 Score (Students scoring less than the cutoff for 3 will receive a 2)

*The exact cutoff for a 3 score (along with other score cutoffs) will be displayed at the end of the exam.

* This means that students will need to score at least 74 percent to obtain honors and also that a student cannot fail solely based on failing the final exam. These cutoffs were determined after careful analysis of national data from FmCases test administrations in US Medical Schools. The data was analyzed in collaboration with the UWSOM director of Educational Evaluation.

9. Please contact the Clerkship Coordinator as soon as possible with any technical concerns during the exam: 206.543.9425.

10. Exams will not be rescheduled. In case of an emergency, please contact the Clerkship Coordinator.

EVALUATION

Faculty Evaluation of Student

At the conclusion of the clerkship, all faculty and residents who provided in-depth supervision of your work will evaluate you based on the Clerkship Feedback and Evaluation Form (Grade Anchors). Please familiarize yourself with this form and ask your faculty for periodic feedback on how you are performing under this rubric. There is a link to the form from the Clerkship Info for Students page or here:

https://depts.washington.edu/fammed/system/files/Anchors%202012-2013.pdf

Your Site Director is responsible for collecting and summarizing performance evaluations from preceptors you worked with during your rotation. The Family Medicine Clerkship uses this information to ensure consistency between your numeric scores and the evaluation comments and to assign your final grade. Scores and comments from the feedback and evaluation forms are the major determinant of your final grade.

Student Evaluation of Course and Content

On the last day of your clerkship, you will receive an email asking you to evaluate your Family Medicine Clerkship experience. Your responses are confidential and will not be shared with your preceptors until after your grade has been received.

The "Medical Student Evaluation of Clerkship" (i.e. course/clerkship evaluation) is a requirement in order to view your final grade in the E*Value Curriculum System.

UWSOM FAMILY MEDICINE CLERKSHIP

Grading Criteria (2013-14 Academic Year)

The Family Medicine Student Evaluation is composed of twelve scoring categories:

- *Knowledge of Subject*
- **Data--Gathering Skills**
- **Clinical Skills**
- **Patient--Centered Care Skills**
- **Management Skills**
- **Integration Skills**
- **Communication Skills**
- **Relationships with Patients**
- **Professional Relationships**
- **Dependability and Responsibility**
- **Educational Attitude**
- **Clerkship Final Exam***

1. Honors

Students must receive at least ten (10) scores of 5 and no score less than a 4 in any category for Honors.

2. *High Pass*

Students must receive at least ten (10) scores of 4 or 5 and no score less than a 3 in any category for High Pass.

3. *Pass*

The Pass grade reflects the performance of a student at the expected level for a third year clerkship student.

4. *Fail*

A failing grade is based on student's performance taken as a whole and not solely based on any one numeric profile. A 1 in any category will result in a failure. Multiple 2's may result in a failure.

Other Determining Factors:

1. Adherence to the time and attendance policy

Failure to adhere to the policy may result in a fail grade.

2. *Completion of the required curriculum tasks*

Failure to complete any part of the required curriculum, including timely entry of your experiences into your Assignment Tracker form, may impact your grade.

Final Grade

Upon completion of the Family Medicine Clerkship, students can view their final evaluation form on e*Value. Although some evaluations take longer than others to process, our goal is to have final evaluations posted within four weeks after the end of a rotation. Once the Department of Family Medicine has assigned your final grade, you will receive an email notification and a link to view it. Please note that because you will be able to view and print your final evaluations online, we will not be mailing hard copies.

Students who have concerns about their final grade should submit the "Grade Inquiry Form" listed on the clerkship website. Per the School of Medicine's Policy for Grade Appeal in the Required Clerkships, all requests for grade review should be made before 12 weeks following the end of the clerkship. Requests made after 12 weeks will not be considered. The complete policy can be found in the School of Medicine Student Handbook.

SAFETY

The Family Medicine Clerkship follows all School of Medicine Policies with regard to Bloodborne Pathogen Exposure and Infection Protection. The policy document can be found here:

http://www.uwmedicine.org/Education/MD-Program/Current-Students/student-affairs/information-for-students/Documents/Blood-borne-Pathogens-Policy.pdf

Your site orientation should include a discussion of the safety policies and procedures at the site. You should learn the location of necessary protective equipment and ask for anything you find missing during your site orientation. Students are NOT covered by Workman's Compensation for injuries or illnesses that occur while participating in school activities. We strongly encourage you to buy both health and disability insurance. Affordable health insurance is available to all University of Washington students. For more information, call the UW Student Insurance office at (206) 543-6202 or the HHPCC patient care coordinator at (206) 616-1881.

InfectionPrevention

Hand washing protects both patients and healthcare providers; wash hands before touching patients and before and after glove use. Gloves are worn before contact with the patient's mucous membranes or open skin, even for injections and suture removals. Contaminated gloves are removed and discarded into an appropriate waste container. Gowns and/or plastic aprons are used to cover areas of the skin or clothing that are likely to become soiled with body substances during patient procedures or care. Facial barriers including masks, glasses/goggles and face shields are worn whenever splashing or splatter of body substances into the mouth, nose or eyes could occur. Masks are also used for certain airborne diseases. Other barriers such as hair covers, shoe covers and boots may be used when extensive exposure to body fluids may occur (e.g., cystoscopy, vaginal delivery, multiple trauma).

Sharps Management

- Make every effort to prevent accidental injury to yourself and co-workers.
- Discard all used sharps into rigid impervious containers.
- Do not routinely recap contaminated needles.
- Forceps may be used to carefully remove contaminated needles or knife blades.
- Additional "safe" sharp practices are applicable in the operating room or during special procedures.

Immunization

The School of Medicine requires all students to be in compliance with the Health Sciences Immunization Program requirements. For more information on this Program, refer to the Student Handbook

POLICIES

The Family Medicine clerkship follows all policies set by the School of Medicine for the following areas:

1. Clerkship Scheduling Policy
2. Clerkship Absentee Policy
3. Work Hours Policy for Required and Elective Clerkships
4. Grade Appeal in the Required Clerkships
5. Planned Delay in Grade Reporting in the Required Clerkships
6. UWSOM Student Mistreatment Reporting and Response

These policies may be found in the University of Washington WWAMI Student Program Handbook. Students who feel that there has been a violation of any of the above policies should contact the Clerkship Co-Directors.

For more information, go to the UW SOM Student Handbook at:

Currently the Handbook is off line, it is expected to become available in August 2013, The Clerkship Absentee Policy is posted on the clerkship website under "Info for Students"

Travel

All clerkship travel questions are handled by the Dean's Office. For more information call the Travel Desk at (206) 685-7147 or go to: http://depts.washington.edu/gowwami/

Ethics

Students should familiarize themselves with Ethics in Medicine at http://depts.washington.edu/bioethx/.

The aim of the resource is to expand and integrate bioethics education throughout the medical school curriculum. The topics, cases and resources are to be used as a resource by the UWSOM community and to supplement or support other teaching and learning throughout the curriculum.

*Equal Opportunity Policy**

The Family Medicine Clerkship and the Department of Family Medicine reaffirm the University of Washington's policy of equal opportunity in education regardless of race, color, creed, religion, national origin, sex, sexual orientation, age, marital status, disability, disabled veteran or Vietnam era veteran status.

Students with concerns about their clerkship experience are encouraged to contact one or more of the following individuals:

1. Your Clerkship Site Director
2. Misbah Keen MD MBI, MPH
   Director, Family Medicine Clerkship
   mkeen@uw.edu, Telephone: (206)
   543-9425
3. Contact University Ombudsman for Sexual Harassment and
   Dispute Resolution at (206) 543-6028.

*Discrimination is prohibited by Presidential Executive Order 112246, as amended, Washington State Gubernatorial Executive Orders 89-01 and 93-07, Titles VI and VII of the Civil Rights Act of 1964, Washington State Law Against discrimination RCW 49.60, Title IX of the Education Amendments of 1972, State of Washington Gender Equity in Higher Education Act of 1989, Sections 503 and 504 of the Rehabilitation Act of 1973, Americans With Disabilities Act of 1990, Age Discrimination in Employment Act of 1967 as amended, Age Discrimination Act of 1975, Vietnam Era Veteran's Readjustment Assistance Act of 1972 as amended, other federal and state statutes, regulations, and University policy.

(Updated August 2013)