Measuring Thinking Worldwide

This document is a best practices essay from the international, multidisciplinary collection of teaching and training techniques, “Critical thinking and Clinical Reasoning in the Health Sciences.” Each essay in this set provides an example of training reasoning skills and thinking mindset described by international experts in training clinical reasoning.

Problem-Based Learning in a Competency-Based Medical Assistants Curriculum

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We had the pleasure of meeting Professor Tomczak at the Inaugural Nova Southeastern University Conference on Critical Thinking and Clinical Judgment. Dr. Tomczak has been a professor of Podiatric Medicine and Surgery at Des Moines Medical University in Des Moines, Iowa, and a clinical professor at the Ohio State University Muscular Skeletal Institute in Columbus Ohio. He also holds a doctoral degree in Adult Education from Drake University. Currently he is the Chair of Education at Everest Institute, and co-chairman of the Problem-based learning curriculum for Ohio State University College of Medicine.

We know you will enjoy the lesson he is sharing here in this chapter, as well as the classic references on teaching and learning. Yes, there really is a reference here from the 1890 Journal ‘Science.’ Through the use of clinical scenarios he teaches phlebotomy students about the unexpected variation of problems that present in clinical practice. We see where training critical thinking is an integral part of training clinical expertise and sound clinical reasoning. Thank you, Dr. Tomczak, for your wonderful humor and for this creative problem-based learning exercise.

Background

There is a huge difference between hitting a baseball placed on a tee, something small children do, and hitting an 85 mph curve ball. One can easily stand in a batters’ box and employ the same mechanics repeatedly and learn to hit that ball off the tee fairly consistently. Unfortunately, as one progresses through the athletic milieu, the variables such as speed and arc of the ball, psychological distractions like crowd noise, and topography of the batters’ box change. Those who can’t hit the curve under these evolving circumstances have no chance to make the major leagues.

In the television show Star Trek there was constant psychological tension and hermeneutic disequilibrium between Spock and Kirk. Strict Aristotelian logic versus Kohler’s Problem Solving by insight was the underlying theme of
most shows. Today, on the TV show *House, MD*, we are treated to the problem-solving skills of Gregory House, MD whose skills are more often than not met with dire consequences and the drama of pulling a patient back from the grasp of death, until another trial and error attempt is made to salvage a soul.

Teaching in the Allied Health Profession is often moving tortuously slow toward a terminal behavior, step by step along a path which at times does not even allow binary decisions. The trainer inches the student along a path toward successful completion of a task, say drawing venous blood from the antecubital space of the elbow. There is no deviation. There’s probably only minuscule differences between the way it’s done in New York and the way it’s performed in San Francisco. Move along in the training process too quickly and mistakes occur and the student reverts to trial and error behavior. Move too slowly and the quick graspers become bored. The steps are always the same, prepare the equipment, make a preliminary choice of a target vein, apply the tourniquet…

I have this friend, a surgeon who was very well trained. I know this is true because I had the same training. I’ve trained many surgeons and have come to the conclusion I could train an ape or robot to perform most procedures. Why? As long as there are no creative decisions to be made, the process of surgery is rather straightforward and as long as the procedure is broken down into step by step tasks, it really is relatively straightforward. More complicated procedures simply mean more steps…unless something goes wrong. Then, problem solving and higher order thinking skills come into play. Now you have to hit that 90 mph curve ball in Yankee Stadium in the ninth inning of the seventh game of the World Series.

My friend never enjoyed operating after completing his residency. The thought of something going wrong terrified him and when it did, he had to actually go sit down in the corner and try and think his way through the problem. He was unpracticed and uncomfortable with the process of problem solving. He eventually quit surgery and went into administration. He couldn’t hit the curve ball.

**Class Session and Students**

A successful Medical Assistant Program has consisted of shaping a number of terminal behaviors, perhaps the most invasive and complicated being phlebotomy. Students vary in age from post high school to adults with grown children. Ninety-five percent of the students are female.

Surgical Interns are initially exasperated by their own fumbling and erratic performance in tying surgical knots. According to the Fitts and Posner model of motor skills acquisition (Fitts & Posner, 1967), this evolves into integration and automation. This automation is best characterized by the late night scenario where the intern is reading while ambidextrously tying surgical knots without paying attention to the motor skill. Medical assistant students do not enjoy the luxury of constant repetition, so a virtual reality arm model with “antecubital veins” is employed for multiple practice opportunities.

Practice makes perfect when there are no variables, and this is the case with the simple mechanics of tying knots. But the human condition is rarely constant, so trying to teach the variables of venipuncture with a model which does not change is the challenge. We need to teach students to hit the curve balls of venipuncture.

The challenge for the professor is to identify these changing variables in venipuncture, and to place them in a problem-based learning scenario which fosters solutions within a clinical context without violating the diagnosis taboo, and yet still allowing for on the spot assessment. One way to have students identify these variables is to guide them to think through the scenario. Major questions to be asked during the scenario include:

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1. “What do you think has happened?”
2. “Why do you think this has happened?”
3. “What will you do to fix it?”
4. “What would you do differently next time?”

Notice that Question 2 asks for reason giving, an important expectation to train for accountability of practice and a way to practice the critical thinking skills of analysis, inference and evaluation. Question 4 targets these three critical thinking skills as well.

Rather than present only one scenario, I offer three examples of the use of clinical scenarios to train critical thinking skills in the performance of phlebotomy. Each asks students to apply anatomy and physiology principles and venipuncture technique, but the patient management problems force the students to confront unexpected clinical events that require critical thinking and competent clinical judgment.

**PROBLEM I**

Information for Instructors: There is a movement in the phlebotomy community to use blood pressure cuffs rather than a thin stretchable band for a tourniquet to cause venous engorgement but allow arterial inflow while performing the blood draw. In an individual with a narrow pulse pressure, or low blood pressure, there is a small margin of error between venous engorgement and complete arterial occlusion.

Scenario (this information is given to the student): The physician who you are working for instructs you to use a blood pressure cuff for a phlebotomy on a 25 year old, female, latex allergic patient because all tourniquets in the office happen to contain latex. As the vacuum tube is pushed into the needle, there is a “blood flash” which quickly diminishes to no more flow. Your attempts to reposition the needle are futile.

Problem prompt: What is your assessment of the problem and plan of action? Here is where the questions above come into play:

1. “What do you think has happened?”
2. “Why do you think this has happened?”
3. “What will you do to fix it?”
4. “What would you do differently next time?”

Process for Problem I

Students can either work individually or in groups on these problems, in class or at home. My goal is to provide them time to evolve some hypotheses about what may be going wrong, and to assess the strength of these hypotheses, resolving the problem of why the blood sample is not forthcoming. This process of allowing for multiple working hypotheses has been known to foster growth in thinking for at least as long ago as 1890 when it was advocated by Chamberlin. Students are expected to feel Piagetian disequilibrium and will want to just be told the answer. Teachers may think it is more efficient to merely tell the students that the blood flow has
been occluded by the cuff pressure, but learning this fact within the context of a patient problem makes retrieval of the information much more accessible (Bruner, 1961), and future curve balls become easier to hit.

This problem actually concerns the medical assistant’s mechanics in relation to the patient’s blood pressure. The medical assistant is using a new mechanism, a blood pressure cuff, which may be over inflated and completely occluding blood flow. Unless the cuff is immediately released, there may be no more flow through the vein into the tube. Release of the valve and deflation of the cuff requires significant manual dexterity when performed with one hand while the other hand is cradling the test tube. It is more complicated than a simple rubber strap which can be released with a simple tug on a free end of the tourniquet. The first question which arises is whether the phlebotomist completely released the blood pressure cuff, an action which requires more dexterity than removing a stretchable tourniquet. On the other hand, the phlebotomist may have punctured completely through the vein or repositioned the needle such that blood flow is halted. Phlebotomists are taught a sequence of actions which should be routinely followed. When blood flow ceases, the needle should be readjusted if the tourniquet has already been released.

The four questions can be asked after the students have some time to digest the problem. Should the scenario occur in “real time” as a blood draw is underway on another student, it is inappropriate to start asking hypothetical questions about what happened. Ironically, this is the opportunity for instructors to use their own problem solving skills to correct the complication which is occurring before their eyes and turn it into a “teaching moment.” This usually happens after the needle is removed from the student-patient donor.

This is an example of an ill-defined problem with little chance of immediately vectoring to a one and only correct answer. As a result, there are multiple avenues for discussion and hypotheses.

**PROBLEM II**

**Information for Instructor:** Medical Assistants may be required to draw blood from a patient whose medical history and present medications are unfamiliar. Patients such as this could be on platelet or anti-coagulation therapy. If routine chemistries or CBC are ordered, the medical assistant drawing blood may not be aware of the potential for hemorrhage.

**Scenario:** You are asked to draw blood from a 65 year old male for serum electrolytes. After filling the red top tube, you remove the needle from the patient, apply pressure with a cotton ball, and then ask the patient to continue applying pressure while you prepare the tube for transport. Before applying an adhesive bandage, you remove the cotton ball and discover a marble sized hematoma has already formed at the puncture sight. What is your assessment and plan of action?

The same questions work to draw out student’s thinking for this problem situation, but in a different order:

1. “What do you think has happened?”
2. “What will you do to fix it?”
3. “Why do you think this has happened?”
4. “What would you do differently next time?”

**Process for Problem II**

The process for this scenario is the same as for Problem 1, individual or group work that allows students time to form hypotheses about the nature of the problem, to seek additional information and move in the direction of the action needed to resolve the unexpected clinical event. This problem involves the immediate assessment of hematoma formation, and regardless of the cause, the student is expected to prevent further hemorrhage. This is an example of the necessity of being able to think accurately and rapidly in an unfamiliar situation, processing information as quickly as possible and adapting to the unknown.
Failure would be to run for the physician without adequate pressure being applied to the venipuncture site. Students immediately want to make the hematoma “go away” as if to correct an error on their part. This can’t be done. Laying blame is not the issue here. The hematoma is likely extravascular and although somewhat startling initially, with the proper treatment, it will resolve. The “why this happened” is not the first consideration. After the hemorrhaging is stopped the analysis of how the problem originated can be addressed, and a plan for the next time can be designed. Should every patient be asked about medication? Should the ordering physician let the phlebotomist know if there is anti-coagulation therapy? Or, should every patient be treated as if they have a tendency to hemorrhage? Fully debriefing this clinical scenario, and fully exploring each of these potential protocol changes for the reasons supporting each, is an exercise that trains critical thinking skills (analysis, inference, explanation, and evaluation) and nurtures the disposition to be concerned about anticipating the consequences of high stakes judgments (analyticity).

**PROBLEM III**

**Information for Instructor:** In this scenario a blood drawer accidentally sticks herself with a needle contaminated with a patient’s blood and in so doing instantly becomes a new patient. For the purpose of this scenario, let us assume that Universal Precautions were taken, but nonetheless this incident occurred. In a moment of crisis such as this, the algorithm for action is often forgotten. I know from personal experience and even after 25 years in the OR, it takes the circulating nurse to calmly initiate the proper protocol and assuage my panic.

In addition to training the students in thinking well about the scenario, a review and improved understanding of the ‘why’ of the proper follow-up procedures are the goals of this problem.

**Scenario:** After completing an exceptionally difficult blood draw during which the patient squirmed and cried, you accidentally stick yourself with the contaminated needle while trying to engage the safety mechanism. What should you do? Once again the four questions all are important.

1. “What do you think has happened?”
2. “What will you do to fix it?”
3. “Why do you think this has happened?”
4. “What would you do differently next time?”

**Process for Problem III**

This is a complicated problem. Using the recommended four questions to externalize students’ thinking about this scenario helps the instructor to assess how well students have learned key information in this most important content area. Although the event is well defined in causation, its occurrence calls for a myriad of possible actions and at best a delayed resolution. My learning objectives for this session include OSHA/HIPPA issues, an exploration of the issues surrounding the patient’s willingness to be tested for communicable diseases, the possibility of infectious disease prophylaxis, and the discussion about responsibilities toward the phlebotomist’s sexual partner. The scenario offers the opportunity to examine the problem in a context of uncertainty. What action must be taken before the definitive exclusion of potential disease?

**Conclusion**

Even among the most seasoned health care professionals, this scenario is carried out on a daily basis around the world. There is a certain assumption of risk which all health care providers who come in contact with bodily fluids must assume. Although the potential for infection is rare, it does exist. For this reason this scenario is particularly useful for training practicing clinicians in all health science fields.
SUMMARY THOUGHTS

I prefer to use this method in the context of problem-based learning rather than problem-based testing. This model serves as a tool to help integrate decision making and problem recognition and resolution into the health professions. Students still perform well on standard multiple-choice tests if the learning process is supplemented with problem- or case-based learning. There should be no fear that “fact transfer time” is diminished by allowing students to think about situations they may encounter which cannot be routinely taught in a classroom or laboratory where simulations are constant and non-variable.

Testing in a competency based problem-based learning curriculum presents a unique set of challenges. Problem-based learning gained its North American foothold at McMaster University in Hamilton, Ontario under the guidance of Howard Barrows, MD a trained neurologist. The original cohort of 20 medical students in 1969 were not subjected to conventional testing but were evaluated through an ongoing subjective process (Neufeld & Barrows, 1974). It wasn’t until 1991 that the personal progress index examination was introduced at McMaster to emphasize to students that, irrespective of the enjoyment of learning in tutorial, the acquisition of a progressively sophisticated medical knowledge base was required for successful graduation from the program (Neville & Norman, 2007).

Malcolm Knowles, the father of adult education, felt a disdain for testing adult learners. He thought that since adults were self-motivated, there was no need for testing (Knowles, Holton & Swanson, 2005). Barrows felt the same way about self-motivation and self-directed learning skills relying more on self-assessment than testing (Barrows, 1986). We are easily able to assess clinical competencies throughout the curriculum at Everest Institute in Columbus, but the assessment of didactic information in a student-directed problem-oriented conceptual fashion, along with judging a student’s ability to handle complications, is more difficult.

Not everyone has joined the problem-based learning method of education. Some prominent medical educators discern multiple practical and philosophical problems with problem-based learning and have not gotten on board (Shanley, 2007). Testing is one of the major problems. The multiple choice high stakes exam is still the bench mark for didactic knowledge and certification. Problem solving skills are rarely evaluated in the Medical Assistant’s world.

The oral examinations we used in the Problem-based curriculum in Des Moines relied heavily on subjective evaluations. As a result, grades were assigned as “Pass” or “Fail.” At Ohio State we used a serial written test where students would complete one section, then turn it in. They would then be given the answers to the first section with additional questions to be answered. This continued a few more times until problem resolution. Students were required to use their critical thinking skills and the fund of knowledge they had learned during the quarter to successfully solve the sequential clinical management problems.

Complications of venipuncture are extremely difficult to examine uniformly on phlebotomy models. These models don’t exhibit life like responses, and some complications cannot be modeled or practiced. We couldn’t, for instance, ask a surgical resident to nick a renal artery to see how he or she responds. We can work through this complication and the correct response in a conference and only hope it never occurs. The same goes for phlebotomy mistakes. We can only pose the problem and then ask:

1. “What do you think has happened?”
2. “What will you do to fix it?”
3. “Why do you think this has happened?”
4. “What would you do differently next time?”

Routine tasks performed on a daily basis by medical assistants can achieve a type of automation, like hitting that baseball off a tee, but, when the situations change and complications arise, medical assistants must be able to adapt.
A lecturer can cover multiple facts, but placing the learning objectives of a lecture within the context of a patient problem allows the student something to hang facts on. It makes them not only more meaningful, but also more retrievable. Research that explores the storage of information as episodic memory probably explains why it is that we are better able to retain information learned in the context of a case scenario (Slovic, Frishoff, & Lichtenstein, 1977).

Patient problems also offer the student the opportunity to constantly reassess thoughts and actions and consider if they might have done something different to improve the outcome. Teachers sometimes fear their own proficiency at conducting these sessions, but beginning with a case presentation and entertaining feedback with the same four questions listed earlier will facilitate implementation of problem-based learning into a lecture-based curriculum. There is no right or wrong way to facilitate problem-based learning. As long as the instructor uses a bit of imagination or real life experiences as a basis to build a case, the students will gain critical thinking skills.

References and Tomczak Teaching for Thinking
Tomczak, R. (1990). The Podiatric Medical Student as an Adult Learner, The Journal of Current Podiatric Medicine, 39, 25...

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